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A New Electrical Street Car.

A STORAGE BATTERY THAT WILL PROPEL A CAR FOR SEVEN HOURS — THE ELECTRIC POWER COMPANY DOING GOOD WORK — CHEAP, SAFE AND EXPEDITIOUS PROPULSION — FUTURE PROSPECTS.

The newly devised electrical street car has been illustrated for the benefit of the readers of the ELECTRICAL REVIEW, not by reason of its perfection as a motor, which, as yet, is not assured, but because it would seem to be the exponent of that system of electrical locomotion of which the charged rail and running wire constructions were the pioneers.

The car, a faithful representation of which is here given, was recently tried on the lines of the West Metropolitan Tramway Company, from Gunnersbury Station to Turnham Green, and thence back to Kew Bridge. Upon the morning of the day of trial the car was tested in the presence of the Government inspector, on the Acton line, and had abundantly demonstrated its ability to do that which had been claimed for it. Smoothly and noiselessly it ran hither and thither, partly filled with passengers, of which it has accommodations for forty-six. The rate of speed attained was six miles an hour, though considerably more than that was shown to be possible.

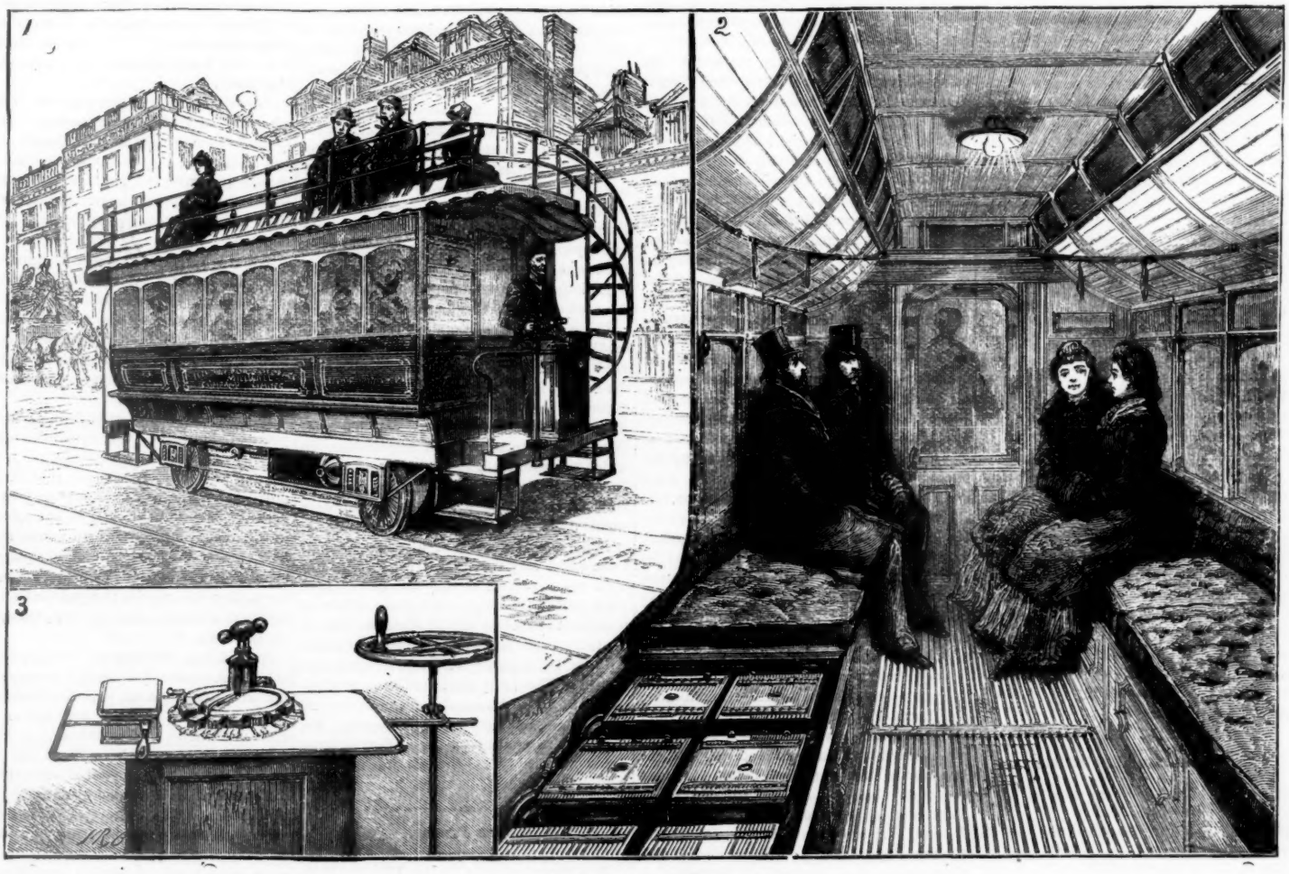
As everyone knows, trial tests of newly devised machinery are rarely satisfactory, and at such times accidents seem more frequent than at others, where less critical observers are at hand. The electrical car was fated to prove no exception to the rule, and after successfully traversing a part of the line in the afternoon's trial, a portion of the machinery, presumably the belts of the driving gear, got out of order, and, while essaying to climb a steep grade in the roadway, the car came to a sudden stop. From what we have heard of the admirable design of this car, we are not inclined to attach any importance to this accident, nor to believe, with some of our English contemporaries, that it portends the ultimate failure of the scheme in hand.

The electrical car tried at Kew Bridge is the last practical experiment undertaken by the Electrical Storage Company. The accumulators are stored under the seats, the current being communicated by insulated wire to a Siemens dynamo machine. This dynamo is made to act like a motor, and is connected with the axle of the wheel. Neatly set in the body of the car is an accumulator, consisting of fifty Faure Sellon-Volckmar cells, each measuring 13 in. by 11 in. by 7 in., and weighing about 80 lbs. The power of this accumulator is capable of supplying a constant motive power to the car for seven successive hours. Of course, the action of the motor may be reversed at will, and, by an ingenious contrivance, the power may readily be increased or diminished, by adding to or taking from the number of cells, by means of an ordinary electric switch. By breaking the circuit the motive power is stopped, and, the brake being then applied, the car is quickly brought to a standstill.

The car, with the accumulators and machinery, weighs 4½ tons, and when loaded with the forty-six passengers which it is licensed to carry, there will be a total weight of 1¼ tons on each wheel. It has been computed that the daily cost of such a car, not including first cost and wear and tear, is 6s. 3d., against 26s., the daily cost of two horses.

For several years, electricians have been busily engaged upon the various problems connected with electric lighting, and have, with few exceptions, paid little attention to electric locomotion, which, there is reason to believe will, at no distant day, be considered of primary importance. The efforts of those few persons who have employed themselves in applying electricity to locomotion have not, up to the present, been rewarded with a very flattering measure of success. The road electrically operated between Berlin and the Studentenhouse, and the other and somewhat similar experiments in other countries, have but demonstrated that their projectors, if not their motors, were on the wrong track; that what has proved successful in the laboratory will not always prove feasible commercially; and, finally, that the cost of maintaining a unit of electrical railway is to the cost of a unit of railway operated by horse-flesh nearly as two is to one.

In the two-rail system, where currents from powerful electric generators were sent along the rails and picked up by the car-wheels *en route*, the public, which it was designed to benefit, were placed in great danger. Men, women and children were seriously injured by coming in contact with the non-insulated electric mains, and horses, while trying to cross the track, connected both mains with their body, were instantly killed. The wire system, also, has not as yet proved any-



THE NEW ELECTRIC STREET CAR.

thing like a commercial success, though it is but fair to say that this has not as yet been fairly tested.

Striking out in a direction, practically speaking, altogether new, the Electrical Power Storage Company showed beyond peradventure, in their recent experiments on the West Metropolitan Tramway, that, even if they had not as yet succeeded in perfecting an electric motor, they had, at least, developed, so to speak, groundwork that contains the elements of success. Here we have no dangerously charged rails, no wire, likely to be perpetually out of order, but a compact, self-governing motor, that can be started or stopped at pleasure, and is, withal, so it is said, more economical, when running expenses are considered, than the ordinary street car.

It is but fair to say, in this connection, that Prof. Ayrton also invented an electric motor, upon a system which required neither specially constructed permanent ways nor overhead conductors; but this system, which was fairly tested last year at Leytonstone, was found to be seriously wanting in some of the principal essentials.

We repeat, we are by no means surprised at the accident which took place during the recent trial at Kew Bridge. No trouble was experienced in handling the electric motor until the permanent way between Gunnersbury and Kew was reached. Here the gauge changes, and the rails were found to be one-quarter of an inch too narrow for the wheels. Instead of turning back when this was discovered, the experimenters, flushed with the success already secured, dashed on, and naturally enough, the belts of the driving gear, or some other part of the machinery, which had not been devised to withstand this extraordinary and unlooked-for strain, gave out, and the trial was at an end.

The measure of success which has been accorded the inventor of this new electrical car is but another proof, if proof were wanting, of the possibilities of the storage battery. The great fundamental principal of mechanical science laid down by Newton, to the effect that to every action there is an equal and contrary reaction, is not limited to the recoil of a gun or the return of a bent spring, but is true also of chemical action, as the storage battery proves. Newton found that the magnet is drawn toward a piece of iron with a force precisely equal to that with which it draws the iron to itself, and a contemporary of his demonstrated that the same law held good also for the force of electric attraction, an electrified body drawing a non-electrified one toward itself, and being itself attracted with an equal and oppositely directed force.

A practical understanding of this principle has given us the storage battery, and through its agency there is reason to believe many things are in the future to be accomplished that our philosophy heretofore recked not of. If the electrical car recently tried on Kew Bridge will run as steadily when in absolute service as it did before it touched the contracted gauge, it may already be set down as an assured success.

The Electrical Exhibition.

(*From the Vienna Correspondent of the Electrical Review.*)

The applications for this exhibition come in more and more numerous and display its international character more and more, for, besides the native exhibitors, we find representatives from America, Belgium, England, France, Germany, Italy, Russia, Sweden and Switzerland in the announced lists, the perusal of which permits now already to give the International Electric Exhibition a favorable prognostic both in respect to quality and quantity. For almost every one of the groups which the exhibition will be compounded of some very interesting applications have come in, and few specimens of them will certainly be of general interest; we will, however, by citing them adhere more to a chronological turn of the entrances than to an arrangement in groups.

The *Société Anonyme d'Electricité* at Paris presented itself first with an announcement, embracing almost all departments of electro-technic; it includes no less than eight various dynamo-electric machines, three electro motors, lamps of different systems, microphones, telephones, secondary batteries, telegraphs of new systems, a regulator for light-houses, etc.

The society has also promised to send a dynamo-electric machine for serving 100 arc or 1,000 incandescent lamps. About as soon Prof. C. W. Zenger, from Prague, famous for the admonition employed on electricity, has announced a rich collection of scientific instruments and apparatus, among them are to be mentioned an universal rheometer, a universal electro-meter, a new gas column, and a new accumulator. Next to him we mention E. Hartmann, from Wurzburg, who has gained an acknowledged reputation by making the instruments for the prominent natural philosopher, Prof. Kohlrausch, and who has promised to exhibit a considerable number of scientific instruments and apparatus. Next we mention Charles Foster, of Birmingham, who will exhibit besides apparatus for studies, miniature gas-motors, batteries for electric lamps and electric toys—a welcome delight of the eye for grown and little children. Highly important for the department of electric acts of illumination is the announcement of Piette & Krizik in connection with the engineering firm of E. Skoda at Pilsen, who have promised to exhibit a steam engine of 60-horse power, six dynamo machines, regulators, etc., also sixty arc lights, eventually one light of 20,000 candles. Belonging to the same department we mention yet Buss, Sombart & Co. at Magdeburg, who will exhibit besides a rich collection of apparatus for illuminating gas-motors for galvanic purposes, tachometer, etc.; Gregor Tichmeneff at Bender, and last, not least, the *Companie Continentale Edison* and the *Société Electrique Edison* at Paris, who represent the system of the great inventor from Menlo Park in Europe, and who intend to send among other objects the complete installation of a dynamo-electric machine for the impulse of 500 incandescent lamps. A highly interesting announcement, particularly attracting for the public, is that of the "*Wiener Privat Telegraphen-Gesellschaft*," which by effecting a communication between the Opera-House and the Rotunda by means of telephones will offer the visitors of the exhibition an opportunity of enjoying the performance of an opera every night. We mention further respecting this department Heinrich Muchalski at Lemberg, who raised such an excitement at the Paris exhibition by his telephonic communication between Paris and Le Mans, a distance of 500 kilometers, and Zellweger & Ehrenberg at Uster (Switzerland); who attained a great success in Munich, and who have furnished a great many cities in Switzerland with telephonic installations, Mourlon & Co. at Brusselles, and Stefan Horner, Jr., at Budapest, who will expose low sounding music, song, and conversing phonophones.

Very well represented is the group of galvanic elements, batteries, accumulators, and thermo-electric batteries, which will offer many new things worth seeing. First of all we mention here Gaston Planté at Paris, the inventor of the secondary batteries, whose rich and valuable collection we shall speak about more at large before long; next to him Johann Weichmann at Munich, Rebicek at Prague, Popper, H. W. Adler & Co., Daniel Lautensack, and Deckert & Homolka at Vienna, as well as Ferdinand Crestin at St. Petersburgh.

Respecting the group of electric-therapy we mention preliminary Dr. Michael at Hamburgh, with a lighting apparatus for medical purposes; Dr. Isidor Wilheim at Vienna, with an electrolytic battery; Medizinalrath, Dr. Hedinger at Stuttgart, with a battery for galvanacaustic, and an electric mirror for lighting up cavities of bodies. Respecting the group of telegraphs and application of electricity on railway matters we mention this time only the application of the Austrian-Hungarian Company of State Railways with a rich collection of apparatus and signals, among which we mention numerous inventions by the well-known Inspector Politzer, and call attention to an interesting apparatus for the reciprocal correspondence with the type printing apparatus by Johann N. Teufelhart at Vienna.

Not to pass over the transmission of power, so very important for the future, we will mention before the close of our superficial sketch that Messrs. Gravier at Warschaw, Piette & Krizik at Pilsen, and others, whose applications are still to be expected, will exhibit largely in this department. For their interesting experiments water-power of more than 300-horse are at the disposal of the commission located at different places up to 60 kilometers distance. The electric railway leading from the Praterstern to the Rotunda will form a living and attractive illustration of this most modern principle of electro-technic.

Dentistry and the Electric Light.

At the annual meeting of the Odonto-Chirurgical Society of Edinburgh, Mr. W. B. MacLeod communicated "Notes on Electric Light in Dental Surgery." He said there was no doubt that a clear, steady and diffused light, capable of being located within the cavity of the mouth, would be a very great advantage to dentists generally. To those whose misfortune it was to practice their profession in cities which were frequently visited by fogs it would be a still greater boon. Attention had for some time past been directed to electricity as a commercial source of light, and it might now be looked upon as one of our standard sources, although not yet quite ready to supplant its older rivals, gas and oil. In their specialty attempts had been made to render it available, and with some degree of success, as was demonstrated by the two appliances now on view before them. The means for securing a constant supply of power yet required further development, means by which the power would be available at a moment's notice, and at the same time comparatively cheap, before they could hope that it would be adopted generally in the profession. The battery as a source of power was open to the objections of inconstancy, wastefulness, and the need of careful and constant provision.

These faults were certainly considerably modified if, besides the light, the dentist used the mallet or motor, and thus having the battery in more constant use, utilized the decomposition of materials which continually went on after the battery was charged What they wanted was an accumulator, in which the power might be stored and drawn from whenever required, and from which none would escape when not in use, or a small dynamo which would generate it cheaply when wanted, or a general depot, from which they could have a wire and turn it on when desired, as they did gas. These were still in the future, and those who wish to avail themselves of the electric light in dentistry must in the meantime be content with the D'Or battery or Fuller's bichromate battery. The lamp exhibited was a small Swan, of four ohms resistance, and the batteries were each made up of four cells. Mr. MacLeod recommended the Fuller, as being the more cleanly and the less wasteful, and having the greater constancy.

Mica Prisms.

At a recent meeting of the Physical Society, Mr. Lewis Wright read a paper on the "Optical Combinations of Crystalline Films," and illustrated it by experiments. He exhibited the beautiful effects of polarization of light, and the Newtonian retardation by means of plates built up of thin mica films and Canada balsam. The wedges thus formed gave effects superior to those of the more expensive selenite and calcite crystals. The original use of such plates is due to Mr. Fox, but Mr. Wright showed many interesting varieties of them, including what he termed his "optical chromotrope," formed by superposing a concave and one-fourth wave plate on each other. Norenberg's combined mica and selenite plates were also shown.

The Future Economical Generation, Storage and Transmission of Motive Power.

O. H. Landreth, (*in the Artisan.*)

Next in importance to producing a salable commodity comes the item of getting it to market at the right time, in other words, *transportation* and *storage* are not less important than *production* in our public economy. This is none the less true in reference to the storage and transmission of motive power or mechanical energy, than to the transportation of material products.

Our recognized sources of mechanical energy are, animal power, combustion of fuel, waterfall, utilization of solar heat, tidal and wind force. Let us consider the actual utility of each of these. Adopting the accepted conventional equivalent of *a horse power* as our unit of energy for comparison, we find that one-horse power derived from draft horses or mules costs us from 18 to 28 cents per hour, and owing to the comparative large agricultural area demanded for maintaining draft animals, which in future will be needed for the support of the general population, this cost may be expected to be considerably increased.

This power, moreover, is more suitable for draft purposes than the generation of productive energy on a large scale.

Considering combustion of fuel, we find that one-horse power costs from 3 to 6 cents per hour through the medium of coal and the steam engine. Unlike power derived from horses, steam power is capable of more economical development in large than in small quantities, but on the other hand is less easily transported, being comparatively stationary.

Notwithstanding the apparent relative cheapness of cost of steam power, we are at present ulilizing only about one-sixth of the full mechanical equivalent of the fuel consumed, and our lavish waste of the remaining five-sixths must very materially hasten the time when our coal supply shall be exhausted.

Water power costs us—all things considered—about the same as steam power, and is even less capable of utilization wherever needed. Streams having heavy water-fall being usually remote from mechanical centers which are usually located on navigable streams, or on the seaboard, or at least in valleys.

In the utilization of solar heat we have, as yet, done but little. Our possibilities in this direction are great, for the supply is unlimited and perfectly distributed, though intermittent. With no greater efficiency in converting heat into work than we have obtained in the steam engine, we may count on one horse power from every hundred square feet of surface exposed to solar radiation, but for utility we require the practical solution of the problems of *concentration*, *storage* and *transmission*.

In utilizing wind power we are, as with solar heat, pratically unlimited in our supply, but have to combat the same disadvantage of intermittence of action; our power here costs us from 5c. to 8c. per hour.

Tidal action may be utilized by water motors, actuated by the fall of water through difference of level created by damming back tidal flow and ebb. The cost of the necessary work, such as docks, dams, etc., will be so variable as to preclude even an approximate estimate of the relative cost of power. Its sphere of action will be limited to mechanical centers on the sea coast, where tidal flow is considerable, and where the necessary dockage grounds may be obtained; these in extent may be estimated for the average rise of tide, to be one-half acre for each horse power continuously developed. As these storage grounds will only be available where they may easily be detached from the sea by short embankments, we may consider the extensive utilization of tidal energy to be quite improbable.

Reviewing these several sources of energy with a view to the most economical future development of power, we find that in order to utilize solar heat, wind, and water power—the three most promising sources of future

energy—that we must provide: First, some efficient system of storing up the mechanical effect which will necessarily be generated interruptedly; second, some efficient medium of transmission of the power thus generated from the place of generation to the place of use, oftentimes of necessity several miles apart.

A few years since it was believed that compressed air would be the medium which should supply both these requirements, and to a certain extent this has been realized, but the great loss of efficiency due to internal heating during compression, and cooling during expansion, cost of maintaining air-tight reservoirs and mains and other mechanical obstacles in practice confine its usefulness to subterranean and submarine work.

The transmission of power by wire ropes, shafts, steam mains, etc., only undertakes one feature of the problem, and in that is necessarily limited to short distances.

At present the most promising agent from which to expect the solution of this important problem is electricity.

By applying power—from whatever source derived—to a dynamo-electric machine, such as is used in electric lighting, we are now able to convert 90 per cent. of the mechanical energy expended into *electric energy*. We may transmit this under ordinary conditions at a loss—due to electric resistance—of 2.5 per cent. per mile. The remainder may be converted into mechanical work by using a similar dynamo-electric machine with an efficiency of at least 80 per cent.; so that our power may be transmitted one mile with a total loss of 30 per cent., two miles, with a loss of about 32.5 per cent., etc.

In *storage* we are not less fortunate than in transmission in selecting electricity as the agent. The recent invention of the Faure and the Brush *accumulators* render possible the storage of electric energy as fast as generated, and its restoration to active electric energy and to mechanical work at any time in the near future, with a loss of not more than 15 per cent.

Here is, doubless, the solution of both phases of our problem. Water power may thus be utilized *wherever* found, wind power *whenever* found, and the invention of an inexpensive solar engine will give us the right to take the same liberty with the beaming smiles of Old Sol.

Electric Motors on the Track.

EXPERIMENTS AT GREENVILLE.

The motor in question is one which Leo Daft, the electrician of the Daft Electric Company, has been experimenting with for the last eight months, and which he now claims to work with satisfaction both as regards power attained, simplicity of construction, and, most important of all, the matter of cost. Already Mr. Daft's little electric railroad has been visited by well-known railroad officers and men, who have expressed themselves as much pleased with the working of the motor. Among the railroads whose representatives have ridden on the road are the Pennsylvania, New Jersey Central, Erie, and many Western roads. Mr. Daft is now especially considering the question of the introduction of the electric motors upon street railroads, and a company has been organized at Newark under the name of the Daft Electric Motor Company, with a capital of $500,000, to manufacture motors for this purpose. It is proposed by this company to experiment with the motors on some of the Newark street roads immediately with a view to their permanent use, and as soon as two of the motors can be constructed for this purpose they will be placed on the road. Mr. Daft has received an application to furnish the elevated road at Coney Island for the 1st of June with motors, but no contract has been made as yet, and the road probably could not be equipped for the purpose before July. Mr. Daft has also been negotiating with persons in Chicago.

The railroad at the Daft Electric Light Works, at Greenville, is about one-eighth of a mile in length, with one very sharp curve and with a heavy grade, and is laid as an ordinary steam railroad track. The electricity is generated by a powerful dynamo machine, which is also one of Mr. Daft's own construction. It is carried to the rails, through which it runs, a perfectly harmless current. The motor consists of a simple pair of trucks as a basis. Under a platform above the trucks the electrical appliances for regulating the motor are placed, and occupy so small a place that they are hardly noticeable. By a small lever the motor is regulated in speed and the brake is put on. There is another small lever attachment, by turning which the weight of the motor is practically increased, so as to give the adhesive power necessary in heavy grades, and by which a grade of 40 degrees can be ascended. A *Times* reporter, on entering the yard in which the railroad is placed, nearly stumbled over a little motor which rested on the rails, and which weighed only 450 pounds. The same little motor afterward drew a five-ton car at as high a rate of speed as the track would allow. Other motors, adapted especially for a high rate of speed, spun around the track with a load of seven persons so fast as almost to take the breath away from those aboard and send hats flying to the rear. The motor was under full control and could be regulated by a child of eight years. In fact, the brake apparatus was so simple that one gentleman, experimenting by himself and forgetting all about the probable result of not paying attention to the lever, was somewhat surprised to find himself sprawling on the ground and the motor trying to plow through a bumper at the end of the road. For his electric light works, Mr. Daft gets his power from a 50-horse power steam engine, which also runs the dynamos furnishing the current for the electric motors. In regard to the cost of running cars by electricity, Mr. Daft claimed that he could regain 75 per cent. of the energy exerted from the steam engine in running the dynamo, and that he could run the motors 40 per cent. cheaper than by steam. He proposes, he continued, to divide the line of track upon which the electric motor shall run into stations of 25 miles, at each station being a dynamo of the necessary power. On street railways a more favorable showing could be made. The cost of the motor itself would be small in comparison with steam engines, and there would be no need of relaying or changing the present tracks of the street railways and no third rail would be needed. The loss of electricity in the system was very small, and only appreciable by delicate instruments. Any number of motors can be run independently on the same track.

Mr. Daft is a graduate of London University, and has been working in a quiet way in this country, not wishing to make public the result of his experiments until practical results could be attained. The company known as the Daft Electric Light Company has as its officers: President, W. G. Perris; Secretary, J. L. Chapin; Treasurer and General Manager, H. M. Hawkesworth.

An Engine Running Incessantly Sixteen Days and Sixteen Hours.

Tuesday morning last at half-past five the men on duty in the Edison lighting station at Pearl and Fulton streets startled the quiet of dawning by a wild cheer and cries of "Bully for the Laurence! She's done it this time if she never does it again." They were all grouped around an engine used for giving force to the dynamo-electric arrangement of armature and commutators which furnishes light to late workers, such as journalists, in the lower part of town. The engine in question had performed the feat of running at a speed of 350 revolutions per minute for the space of sixteen days and sixteen hours without any cessation. The chief engineer, Mr. Vanderveer, said: "Mr. Edison was the first man to use high-speed stationary engines. He reflected that a locomotive of 200-horse power, when making a mile a minute, as such engines often do, both with trains and without them, was compelled necessarily to make 300 strokes a minute, and this, too, often over a road-bed whose inequalities must cause considerable vibration. So he ordered from Armington & Sims, of Providence, R. I., an engine of 350 revolutions and of 175 horse power, because, obviously, the stationary engine could attain high speed with greater safety than the locomotive. At first we had some difficulty in oiling certain parts liable to get heated and hard to come at, such as the crank pin of the balance wheel and the pin of the eccentric in the governing wheel. But I introduced a modification of the cup that catches the oil. Perhaps without this she could not have run for this length of time without stopping. Mr. Edison calculated that, if she ran sixteen days and sixteen hours, it would be equivalent to a run around the circumference of the globe, 24,000 miles. She is going at a rate equivalent to sixty miles an hour. Multiply that by twenty-four, and we get 1,440 miles for her day's run. Multiply that again by sixteen and two-thirds days, and we get 24,000. She started Saturday, the 10th of this month. Before this run she went eleven and one-half days without stopping."

Photographing Sound Waves.

Prof. Boltzman, the well-known German chemist, has devised a method of photographing sound vibrations directly. A small thin platinum plate was fixed perpendicularly to the centre of a thin iron tympan like that of a telephone. Another platinum plate was fixed near the first so as to form a fine slit between them, and the slit was brought into the focus of a collecting lens upon which sunlight fell. After traversing the slit the rays went to a selenium cell which, with two telephones, was joined up in a circuit with twelve Leclanché cells. Single sounds spoken to the tympan could be heard in the telephones. When the rays after traversing the slit (which varied in width with the vibrations) were rendered parallel and concentrated by a lens on the selenium cell, the apparatus could be employed as a photophone. Intense sunlight concentrated on the platinum plate by means of a solar microscope, and an image of the shadow of the platinum plate thrown upon a glass plate prepared with Vogel's emulsion, gave a photograph of the sound vibrations, when the prepared plate was rapidly moved in a direction perpendicular to the line of light. For the vowel sounds the curves are simple, for the consonants, complex, those for *l*, *m*, *n*, *r*, *p* and *k*, resembling those formed by Konig for *r*, by his tone flames.

The Eye and the Electric Light.

There is no doubt that staring at a powerful electric light is deleterious to the eyes. Most electric-light engineers employ spectacles of blue or neutral-tinted glass to examine the arc by. The cause of the damage done to the sight is generally attributed to the intense brilliancy of the light dazzling the optic; but recent experiments by M. Chardonnet, brought before the French Academy of Sciences, show that the excess of ultra-violet rays may have something to do with it. He finds that the crystalline lens of the eye absorbs the ultra-violet rays of light, and that persons who have had it removed in operations for cataract can see the ultra-violet rays. As the electric arc is rich in ultra-violet rays, M. Chardonnet thinks that they may fatigue the eye abnormally. The light of an incandescent lamp, such as that of Edison, gives out, on the contrary, little or no ultra-violet rays, and M. Chardonnet, therefore, believes it better suited to the eye-sight. Nevertheless, the incandescence lamp requires to be hidden from the eye by semi-transparent or clouded screens, for the intense brilliancy of the carbon filaments cannot be looked at without impairing the eyesight, for a time at least.

At the International Exhibition of Electricity to be held this year in Vienna, there will be a pavilion specially constructed by direction of the Emperor of Austria, in order to show the effects produced by the electric light on draperies and embroidery. Different systems of electric light will be tested.

Study of Atmospheric Electricity.

Among the useful applications of Mascart's electrometer is the photographic registry of the variations in atmospheric electricity. It is necessary to maintain a perfect insulation of the different portions of the apparatus; otherwise, instead of getting a curve which represents the variations of atmospheric potential, the curve will be some unknown function of those variations, and of the greater or less conductibility of the supports. Dampness, dust, spider webs, etc., are the principal disturbances of insulation. The automatic record is made by sending a beam of light in a constant direction upon the mirror of the electrometer, which reflects it to a sensitive photographic plate moving uniformly in a direction perpendicular to the plane in which the reflected ray is displaced by the oscillations of the mirror. Since continuous observations are the only ones which take into account the varied and frequent modifications of atmospheric electricity, this method is very valuable, and will doubtless lead to interesting results.—*L'Electricien.*

The new lessees of the Theatre-Royal, Edinburgh, have resolved to light up this theatre after June by electricity, and have entrusted the work to Mr. J. E. Jackson, manager of the Electric Carbon Storage and Apparatus Manufacturing Company of Scotland, Leith. The lights will be a combination of the self-regulating dynamos, Forbes accumulators, arc, and incandescent lamps.

In a lecture before the Harvard Finance Club the other evening, Edward Atkinson presented some interesting statistics regarding fire as a factor in our national taxation. The value of property destroyed by fire in the United States during the last year was $90,000,000. Hotels were consumed at the rate of one and a quarter daily, schoolhouses at the rate of one weekly, and college buildings at the rate of one a month. The expense of maintaining the fire insurance companies was $25,000,000, while the money paid for insurance on the property destroyed footed up to $60,000,000, which has also to be considered under the head of expenses. From these statistics, Mr. Atkinson argued that the fire tax of the United States was from ten to fifteen per cent. of the annual income of the people.

EXPERIMENTAL CONFIRMATION OF A PHENOMENON PREDICTED THEORETICALLY CONCERNING THE DISTRIBUTION OF THE GALVANIC CURRENT IN CONDUCTORS.—G. Poloni.—The author demonstrates Volterra's proposition that when a circuit *e*, is passed by means of two points of entrance, *A* and *B*, into a body in which the conductibility varies continuously from point to point, so there exists at the points, *C* and *D*, a given potential difference, the same potential difference appears between *A* and *C*, on passing the current between *C* and *D*. For this purpose the author uses a sheet of tinfoil; cut in various forms, and a broad parallelopipedal box of copper through which is passed a copper spiral; the current of a battery is passed through two points, *A* and *B*, by means of applied electrodes of rounded copper wire, and two other joints, *C* and *D*, are connected with a mirror galvanometer, the deviations of which are proportional to the potential difference in *C* and *D*. Then *A* and *B* are exchanged with *C* and *D*. The results agree with theory in many modifications of the position of the four points.—*Wiedemann's Beiblätter.*

The Edison electric light plant in the House of Commons, London, will be actuated by a steam engine made in this country. This fact evidently chafes the editor of the London *Engineer*, who, when commenting on what he naively terms a discrimination against the mechanics of Great Britain in the admission there of all machinery free, while the United States lays a tax of forty per cent. upon like importations, hopes, sarcastically, it may prove more efficient than American engines in England have done heretofore.

The Transmission of Power by Electricity.

So much interest is now being taken in this subject that we feel as though we could not give too much information concerning it. We extract some remarks from the *Engineer* which will be found of value:

"Those who have read with due care the series of papers by Professor Oliver Lodge "On the Transmission of Power by Electricity" are, no doubt, by this time competent to pronounce an opinion concerning the value of various schemes much talked of for utilizing in one locality power generated elsewhere at a distance. It will not be out of place, however, to put what Professor Lodge has told the readers of the *Engineer* in a somewhat different light. We have nothing to add to what he has said concerning the numerical values of certain results and the mode of caculating the power which may be realized under given conditions. But it may be as well that a few of the general principles involved should be put in a very clear light indeed before a public which, if we are not mistaken, will ere long be tempted to invest money in schemes of no smalt apparent promise and importance. The prominent idea is the utilization of water power. Turbines or wheels are to be erected in various parts of the country in all sorts of out-of-the-way and inaccessible places. These wheels are to drive dynamos, and the dynamos are to produce currents of electricity, which are to be employed in actuating motors which are to drive machinery. This, for example, is the foundation of the enterprises of M. Marcel Deprez, concerning which something has already been said in our columns. Nothing will be lost, and something may be gained, by explaining in a few words what all this means. The dynamo depends for its action on the fact that if a coil of insulated wire is carried close past the poles of the magnet, one current of electricity will be generated in the coil as the wire comes under the influence of the magnet, while another and opposite current may be said to flow as the coil goes out of the influence of the magnet. Considerable resistance is offered to the motion of the coil either into the field of influence of the magnet or out of it, and it is in overcoming this resistance that work is done by the engine driving the dynamo, and the resistance bears a certain relation to the current produced. Now, if instead of driving a dynamo with a steam engine we send a current of electricity through its wires—if, that is to say, we reverse the original process—then the dynamo will revolve, and a belt from a pulley on its axis will transmit power and drive machinery. The first question which springs to the lips of the engineer who learns this truth for the first time is, "How much of the power expended in driving the first dynamo can I get back from the second or driven dynamo?" and it is to answering this question that Professor Lodge has mainly addressed himself. It will be seen from what he has said that the answer depends on many things; but above all, it depends on the dimensions and insulation of the wire by which the current of electricity is led from one machine to the other.

A current of electricity is made up of two factors—first, quantity; secondly, potential, or, as it is now beginning to be called, pressure. There is an analogy between the action of water and that of electricity, in that the power of both to do work depends on the two factors pressure and quantity. A very small quantity of water under great pressure can do much work; so can a large volume of water under a small pressure. In the same way the frictional electrical machine produces an extremely minute quantity of electricity, but at a tremendous pressure. The quantity is, however, so small that it can do little or no work; and the frictional electrical machine has only been utilized in the arts to supply sparks to explode primers in blasting operations. On the other hand, dynamos may be made to supply huge quantities of electricity at so low a tension as to be useless for all purposes of driving machinery. Now, the resistance of a wire or other circuit to the flow of a current of electricity is, so far as is known, proportional only to the quantity. Thus, with a given size of wire, and a given impulse or pressure, a given quantity of electricity can be sent. By doubling the wire in sectional area twice the quantity will be transmitted with the same driving power, and so on. When electricity has to be transmitted to a distance it is better to increase its tension than its quantity, because a much smaller wire will suffice. The power being constant, the sectional area of the wire may be continually diminished as the pressure, or tension, or potential, call it what we will, of the current increases. For this and for other reasons very fully explained by Prof. Lodge, it is essential that electricity of high tension should be used if the power is to be transmitted without great loss over long distances. Pressure is expressed in terms of volts, current in amperes, or more strictly in coulombs, which mean amperes per second. Thus, in any given case we have first to ascertain the resistance to be overcome by the electricity in passing through the transmitting core. Let us call this, for the sake of illustration, 1,000 ohms, although nothing like this resistance will be met with in practice. Next we have to ascertain the pressure. Let us suppose this to be 100 volts, then $\frac{100}{1000} = 0.1$, that is to say, 100 volts can only force one-tenth of an ampere per second through a resistance of 1,000 ohms. Multiplying our 0.1 ampere by 100, the electromotive force, we have 10, and dividing this by 746, we have by a well-known formula, $\frac{10}{746}$ of 1-horse power.

If our readers have followed us thus far they will preceive that every wire has a certain co-efficient, as we may term it, which controls the power that can be sent through it, and, the resistance being known, the power transmitted becomes purely a question of volts and of nothing else. Doubling the volts much more than doubles the power, the resistance being a constant. Thus, if, instead of 100 volts, the electromotive force in the foregoing case, we suppose that we have 1,000 volts, then the figures will stand $\frac{1{,}000 \text{ volts}}{1{,}000 \text{ ohms}} = 1$ ampere, which, multiplied by 1,000 volts, and divided by 746, gives us $\frac{1{,}000}{746}$, or over 1.34-horse power, and this is just what would be expected; for not only is there a larger quantity of electricity passed through the wire, but that electricity is delivered at a higher pressure at the working end. Just the same result could be achieved by keeeping down the resistance. Let us, for example, suppose that we go back to our 100 volts, but that we reduce our resistance from 1,000 ohms to 10 ohms, we have then $\frac{100 \text{ volts}}{10 \text{ ohms}} = 10$ amperes, and 10 amperes multiplied by 100 volts gives 1,000 and $\frac{1{,}000}{746} = 1.34$-horse power as before. Here we see that the same end is attained by augmenting electromotive force—expressed in terms of volts—ten times, or by reducing the resistance—expressed in terms of ohms—100 times. The reduction in resistance of a wire of any given metal can only be effected either by shortening the wire or by augmenting its thickness, or by doing both. But it is evident that we are prohibited by the conditions from shortening the wire, because we want to transmit power to long distances; and we are prohibited by considerations of expense from augmenting the thickness of the wire. Consequently we must fall back on the dynamo to get us out of the difficulty, and resort to electricity of high tension. Prof. Lodge has shown that to get an efficiency of 90 per cent. it would be necessary to use electricity with a tension of 200,000 volts. So far as is known, it would be absolutely impossible to produce such a tension. Sparks an inch long would fly from the wire, and there would be no practicable method of insulating it. As soon, indeed, as we attempt to produce high-tension electricity from dynamos, we get into difficulties—the risk of burning up the wires on the armature and field magnets being very great.

To sum up, any one desirous of embarking in such schemes as that for the utilization of the water-power of the Rhone, will do well to satisfy themselves that there is a dynamo available for the production of high-tension electricity, which will not be liable to rapid destruction. We are perfectly aware that many inventors and makers of dynamos assert that there is no difficulty in producing such a machine. Such a statement may, however, be very misleading. It is quite true that high-tension dynamos can be made; but whether they can or can not is not the question, but whether they can be made to last, and on this subject there is no positive information of much value extant. Nevertheless, it may be taken as certain that no true progress will be attained in the transmission of power until a machine capable of working with perfect safety up to at least 1,500 volts has been placed in the market. Even then, for anything like long distances, not more than about 40 per cent. of useful effect can be realized at the motor end of the line. Of course, this may be well worth having. Thus, if 1,000-horse power of water be going to waste, a manufacturer might be well content if he got 400 of it delivered at his mill ten miles off at a price represented by the interest on his outlay in plant. There is no difficulty in transmitting *some* power to a distance; but the questions are how much, and at what price, and these, as we have seen, bear the most intimate possible relation to the tension of the electricity produced by the dynamo, and as that is high or low, so may the results be satisfactory or the reverse. Furthermore, it is to be noted that the resistance augments exactly as the length of the line does. Thus, if it be 100 ohms for a given mileage, it will be 200 ohms for a double mileage, and so on. Even though this is the case, it might be worth while sometimes to put down relay stations when the distance is long. Let us suppose, for example, that we have a line whose resistance is 2,000 ohms, and that we work with 1,000 volts, then we can transmit $\frac{1{,}000}{2{,}000} = 0.5 \times 1{,}000 = 500$, and $\frac{500}{746} = .67$ = the horse-power which would be transmitted, of which .33 could be realized. If, however, we cut the line into two lengths, we could halve the resistance, and, as we have seen, would be able to transmit with 1,000 volts 1.34-horse power; 50 per cent. of this might be realized, or .67-horse power. This being employed to drive a second dynamo, 50 per cent. of .67, or .33-horse power, might be had. We should thus obtain just the same result as can be had from the single machine driving over the whole wire. If, however, we could increase the efficiency of the machines over 50 per cent., then there would be a decided gain. Now, the efficiency will augment, other things being equal, as Professor Lodge has shown, with the electromotive force, potential, or pressure of the current employed. But, within certain limits, reducing resistance is equivalent to increasing pressure, but the resistance is reduced by halving the length of the current by putting in a relay, for it is a very different thing to send a current of electricity through one wire with a resistance of 2,000 ohms, and to send the same current through two lengths of wire, each with a resistance of 1,000 ohms. The system of using relays is well known in telegraph engineering, although a telegraph relay is not the same thing as that concerning which we write; and it may be found quite possible to put relays into long transmission lines in other ways than by the insertion of a motor and dynamo. For example, it is by no means clear that the storage battery may not be used with advantage for this very purpose. The thing gained is, of course, the possibility of transmitting more power over a given distance than can otherwise be transmitted with a given electromotive force, and the more high tension can be dispensed with in dealing with electricity the better.

In Spain an installation of Gramme arc lamps is about to be made on the Barcelona and Tarragon railways.

Storing Electric Energy.

(*Continued from page* 10, *March* 29*th.*)

Another mode of overcoming the difficulty due to the retained charge of secondary batteries, is to divide the current from the dynamo machine, one portion passing through the helices of the field of force magnets and another portion going to charge the secondary batteries.

Still another way of obviating the trouble is to charge the field of force magnets from an independent source of electricity.

By observing these precautions, the irregular power of wind wheels, tide wheels, and other like waste forces can be converted into electricity, and, by means of secondary batteries, transformed into a constant power of less force, or a greater power for a less period of time.

It is impossible to fully realize the consequences that must follow from the combination of electrical storage of energy with the dynamo-electric machine. The dynamo-electric machine, standing alone and unsupported by electrical storage of energy, is truly a great power, largely tending to develop the practical use of electricity; but in alliance with the secondary voltaic action, in a perfected form of battery, the practical value of the dynamo-electric machine will be increased a hundred-fold. Things that are impossible to be done with the unaided dynamo can be easily accomplished by this combination. Coal could be burned at the mines, and by engines and dynamo machines be converted into electricity and transmitted over wires to the cities and be reconverted into available power-giving form by electrical storage.

Water powers that are remote from railways could be converted into such power on the line of railways. Such electric transmission of power is already feasible, and the constant accumulation of a water power in secondary voltaic energy during twenty-four hours would exceed the power of the water during ten hours, after all deductions for loss were made, and the losses need not be large even over long distances.

Eminent electricians express themselves with confidence in this matter.

Sir W. Thomson showed, in his inaugural address last year to the British Association, that if it were desired to transmit 26,250 horse power by a copper wire half an inch in diameter, from Niagara to New York, which is about 300 miles distance, and not to lose more than one-fifth of the whole amount of work—that is, to deliver up in New York 21,000 horse power—the electromotive force between the two wires must be 80,000 volts. Now, what, asks Professor Ayrton, is to be done with this enormous electromotive force at the New York end of the wires?

The solution of this problem, he says, was also given by Sir W. Thomson on the same occasion, and it consists in using large numbers of accumulators. All that is necessary to do in order to subdivide this enormous electromotive into what may be called small commercial electromotive forces, is to keep a battery, of 40,000 cells, always charged direct from the main current, and to apply a methodical system of removing sets of 50 and placing them on the town supply circuits, while other sets of 50 are being regularly introduced into the main circuit that is being charged. Of course this removal does not mean bodily removal of the cells, but merely disconnecting the wires. It is probable that this employment of secondary batteries will be of great importance since it overcomes the last difficulty in the economical electrical transmission of power over long distances.

Probably the present storage battery bears as much resemblance to the future accumulator, as the bladder which Dr. Clayton used as a gas holder in 1688 does to the gasometer of city gas works, or as James Watt's crude steam engine does to the Atlantic steamer. When the accumulator of the future has been built, it will be more easy to say what the limit of its use will be, but at present we have to deal with less perfect forms; but the constant and varied thought which is being given to this subject will certainly establish every fact in connection with the

storage of electrical energy, and it is safe to predict that a perfect secondary battery will be produced, and the fitful but tremendous forces of nature, by the agency of the dynamo machine and the storage battery become the main spring of our light and power-giving systems of the future.

The modes of charging are not as readily multiplied as the forms of batteries, because of the almost endless variations that can be made when dealing with chemical combinations, and the uses of secondary batteries run out in so many directions that a field is open for inventors in the adaptation of this stored energy to work out a variety of operations.

It seems to be advantageous to charge secondary batteries, for the first time, with a galvanic battery.

The depolarization of the conducting electrodes in galvanic batteries is usually effected by oxygen, but it can also be done by chlorine and greater energy be obtained.

Chlorine is an easily produced gas, and it affords constancy of action and great energy, and may be found available in secondary voltaic batteries.

The chloride of silver battery recently used by Warren de la Rue consisted of 14,600 cells, and gave wonderful results.

The battery consists of a zinc electrode, unamalgamated, with an electrode formed of a cylinder of chloride of silver melted around a silver wire. The liquid is dilute sal-ammoniac.

This form of battery was designed for experiments of short duration, but it is found to act without polarization during long uses; during its action zinc is substituted for silver in the chloride; there is no hydrogen evolved, and consequently no polarization.

A secondary battery involving the same action as the chloride of silver battery, with the absence of local or internal action as long as the circuit is open, would be a welcome addition to the list.

Professor Forbes' Accumulator.

The Electric Carbon Storage, &c., Company of Scotland, states that it is now able to supply these accumulators. We read that they have been very thoroughly tested, and have given most excellent results. Whereas all other accumulators are of 2¼ volts electromotive force at most, these of Prof. Forbes give generally 2½, and can be made to give 2¾ volts in practice, thereby effecting, as is well known, not only considerable economy in first cost, but also in working. Thus, according to the company's circular, 100 *of Forbes' accumulators are equal to* 125 *of the ordinary kind in first cost, and again in working.* The economy in working occurs because that the potential of the cell being so much higher, and fewer cells therefore required, the total internal resistance of the battery is less and the current is forced across this lower resistance at greater head or pressure. The formation of sulphate of lead during repose, so great a drawback with the carlier accumulators, *sometimes rendering them useless is not perceptible in Professor Forbes' accumulator*, even to careful observation. These accumulators, where installed by the company or its agents, will be guaranteed, and will be generally guaranteed when they are to be used under the direction of a competent electrician. For incandescent electric lighting, the accumulators are made in two sizes respectively, to give light for five hours and for ten hours. The prices of the accumulators will be found on comparison to be lower than those of any other company, while, as shown, the practical results are much better. Small self-regulating machines for charging these accumulators can be obtained of the company (only).

The incandescent lamps manufactured by the company are extremely simple in construction, and have been found to give most economical rasults, and in light afforded will be found to be equal to any in the market; but the company is prepared to supply those of other makers if desired. These lamps are of sizes varying each from two candles, and are suitable for all purposes. When desired the company will supply an engineer to advise and assist in making detailed estimates. With regard to dynamo machines, those supplied by the company are the only self-regulating ones patented in Europe, and are far superior to any dynamo yet introduced.—*Electrical Review.*

On the Corrosion of the Copper Plate in the Daniell Cell.

(*Translated for the* ELECTRICAL REVIEW *from La Lumière Electrique.*)

In the Daniell cell with the porous cup, in which the positive plate is formed of a sheet of copper, it is often observed that, when the cell has been in service for a certain time, the copper plate corrodes at the place where it emerges from the liquid, and that this corrosion may be active enough even to eat the plate in two.

Messrs. A. Candeli and R. Velani have recently recalled attention to this phenomenon, and have endeavored to discover the exact causes of it. It has been said that the corrosion was due to the action of oxygen dissolved in the water, and it has been further stated that the corrosive action is favored by the electrical conditions to which the copper is subjected.

The last assertion is evidently erroneous. If we reflect that, when the battery is in action, the current tends solely to carry to the copper the metallic elements, such as copper or hydrogen, it will be seen that in this fact there exists no cause for oxydization of the copper, and that, therefore, this phenomenon ought not to be produced when the battery is in action.

To demonstrate this, Messrs. Candeli and Velani have set up several Daniell and Callaud cells, of which the positive poles were each formed of a very fine copper wire. They then placed the cells on short circuit, taking care to renew the supply of sulphate of copper. At the end of one month the wires showed no signs of corrosion. The portion of the wire on a level with the surface of the liquids in the Daniell cell, and the portion of the wire passing through the zinc in the Callaud cell, only showed a black deposit of zinc.

In another similar cell they placed around the copper wire forming the positive pole a series of copper wires of varying thicknesses, well insulated from the zinc and not included in the circuit. At the end of 24 or 36 hours some of these wires were eaten in two.

On the other hand, in the cells which remained on closed circuit during one month, they have substituted much thicker wires for the thin ones, and then left the circuit open. Some days afterward these conductors were broken.

It is, therefore, established beyond a doubt that the corrosion takes place during the period of repose, and not during the time of activity of the cell. The phenomenon which gives rise to this corrosion is easy enough to comprehend. It belongs to a class of well-known electro-chemical effects, of which the prototype is the experiment for producing crystals of tin. If a sheet of tin be placed in a test-tube, in the bottom of which has been placed a concentrated solution of the protochloride of the metal, and there then be poured on this liquid either water or a dilute solution of the same salt of tin, there will be formed a sort of local battery; that portion of the sheet of tin which is in the concentrated solution fulfills the function of a positive plate and becomes oxydized, while the part which is in the dilute solution acts as the negative plate, and receives a deposit of tin in the shape of beautiful needles.

The effect in the Callaud battery is analagous to this. The copper plate, immersed above in water and below in the solution of sulphate of copper, forms a complete battery on closed circuit. The copper is, at the same time, both the active and the inactive metal; it is active in the water which it decomposes, and inactive in the sulphate of copper solution. The hydrogen, disengaged by the decomposition of the water, acts on the sulphate of copper, and taking the place of the copper, forms sulphuric acid, which, in its turn, attacking the oxide of copper, reproduces the sulphate.

The equation is as follows:

$$H_2O + Cu = Cu\,O + H_2$$
$$H_2 + Cu\,SO_4 = Cu + H_2\,SO_4$$
$$H_2\,SO_4 + Cu\,O = Cu\,SO_4 + H_2O.$$

Messrs. Candeli and Velani submit the evidence furnished by the two following experiments in support of the correctness of this interpretation:

1 If a copper wire be immersed in a vessel containing two superposed strata, one of the solution of sulphate of copper and one of water, and after a certain time the wire be withdrawn, it will be seen that the corrosion has begun to take place on that portion of the wire corresponding to the line of contact between the water and the sulphate, and that a deposit of metallic copper is formed throughout the length of that part of the wire which was in the solution of sulphate of copper.

2. If we take a glass jar, and place therein a porous cup, and fill the two vessels with water so that the liquid mounts to the same level in both, and then place a copper wire in each vessel and connect the two latter with a galvanometer, there will be no deflection. But if we place some crystals of sulphate of copper in one of the two vessels, there will soon be a noticeable deflection.

It is with the object of avoiding this corrosion that, in the Callaud cell, the copper wire leading to the copper plate, and passing through both liquids, is usually covered with gutta-percha, or else the copper wire is replaced by one of lead. In the latter case there is a chemical action between the lead and the liquid, but a sufficient covering of sulphate of lead to arrest the action is soon deposited. We have, then, only to fear a deposit of zinc on the upper part of the leaden wire—a deposit which results in a slight reduction of the electromotive force.

If in the Callaud cell the action of the two strata of liquid, being visible, can easily be observed, it is not the same with the Daniell cell, and Messrs. Candeli and Velani have not attempted to verify this action in the latter case. It, nevertheless, seems admissible that two strata can readily be formed in the porous cup when a portion of the sulphate of copper has been reduced. The less dense portion of the colored liquid will then rise to the upper portion of the porous cup, while the denser solution will sink to the bottom, thus reproducing the conditions observed in the case of the Callaud cell. It is, therefore, economical to cover the upper part of the copper plate in the Daniell cell with varnish.

A Rich Zinc Mine in England.

The remarkable find of blende (zinc ore) at the Magpie Mine, Derbyshire, England, is exciting great interest in mining circles all over the country. The mine is situated near Bakewell, in High Park, and has been worked for three or four hundred years, with the exception of a short interval from 1843 to 1869. In the latter year it was again opened out, but the proprietors had a prolonged struggle against water, the great enemy of lead mining in North Derbyshire. For nearly two years pumping was carried on at an expenditure of 80 tons of coal per week. During this period the owners raised £19,000 worth of ore, at a considerable profit; but in consequence of the great expenditure of coal, it was thought advisable to suspend pumping and to get rid of the water by driving a level. This work was begun in 1873 and finished in 1881 at a cost of £14,000, the level, nearly 2,000 yards long, unwatering the mine to a depth of 196 yards. A few weeks ago, Mr. Simmons, the captain of the mine, made the discovery of a seam of blende five feet wide, which increases in width the further it is explored. Mr. Simmons regards the discovery as most wonderful and altogether unparalleled in this country. He estimates that there are at least 50,000 tons of ore in the seam, worth £3 18s. 6d. per ton. The company are now making a roadway to their rich deposit, and laying down a four-foot track, on which the ore will be conveyed out of the workings. Twenty yards from this find of ore the workmen came upon an immense natural cavern, 33 yards long, extending from 12 yards overhead and for an unknown depth below water. This cavern was sufficiently large to hold the whole of the debris excavated during six months, and was of great convenience to the company.

Editor Electrical Review.

DEAR SIR,—In an article to the REVIEW of 15th January, I stated that water was a non-conductor of electricity, but I did not state it with sufficient firmness, as I accepted the theory laid down in regard to the electrolysis of water, "that the galvanic current passes from the positive pole of the battery through the acidulated water in the decomposing cell to the negative pole." Faraday has shown that the decomposing force is not at the poles, but within the substance acted on by the current.

We are told "that a piece of polished zinc put into pure water remains perfectly bright for any length of time, and manifests no power of decomposing the liquid. On the addition, however, of a little sulphuric acid, the metal becomes oxydized, and hydrogen is freely disengaged; that the acid dissolves the oxide as fast as it is produced, and thus keeps the surface of the metal exposed to the action of the water; that this function of the acid is perfectly intelligible, but its disposing influence, under which the oxide is first formed, is not well understood."

Well, it's understood, if you accept the fact that owing to water being a non-conductor the acid and metal in combination generate nascent electricity, and that the current is not from pole to plate, through the intervening water and on to opposite pole, but out from the immersed plates and running right and left, and as the water is a non-conductor its compound gases are thereby disengaged, and that the acid and metal is the decomposing force within the substance—water. It is the water only in immediate contact with the plates that is effected; the remainder is quiescent. And so I prefer not to believe "that pure water conducts so imperfectly that it is decomposed with great difficulty," but that it does not conduct at all. GEO. LE CRONIER.

March 26, 1883.

Twenty-five Faure secondary batteries, charged from the "standard" dynamo, and connected with forty of the Edison B incandescent lamps, were installed Wednesday at the Appleton Mills, Lowell. This is the first plant made by the Electric Storage and Light Company of Boston.

M Deherain, who has been following up Dr. Siemens' experiments on the electric light and vegetation, reports on the result of experiments on plants at the Electric Exhibition of the Palais d'Industrie in 1851, and sums up his conclusions thus: "The electric light emits radiations powerful enough to maintain plants in vegetation for two months and a half. The beneficial radiations are not sufficiently powerful to cause the growth of germinating seeds, or to allow of the maturation of fruit in older plants."

Mr. Edward Atkinson, illustrating the advantages of machinery, says it would require sixteen million persons, using the spinning-wheel and hand-loom of less than a century ago, to make the cotton cloth used by our people, which is now manufactured by one hundred and sixty thousand.

The municipal authorities of Moscow have voted a sum of eighty thousand roubles, for the grand illuminations which will take place during the month of May. The citadel of the Kremlin, the ancient residence of the Czars, will be illuminated by forty electric lights, each of 400 candle power. The total length of the conducting wires used will be six versts.

Field Telegraph Without Battery.

In certain special cases, under favorable conditions, the telegraph lines can be extended to battle-fields. However, notwithstanding their lightness, they cannot be moved easily enough to follow up the maneuvers, and very frequently their fragility would render their preservation a matter of great difficulty in the midst of military operations.*

On the other hand, it may be admitted that it would be useless and impossible to use the telegraph at a distance less than 6 kilometers from the front of the army in action; useless, because it would be quicker to send messengers; impossible, because it could not be worked under fire. However, for communication between the main guard and the sentinels, or between the batteries and the posts of observation, endeavors have been made to fit up light telegraphs, capable of being conveyed by a few men; these may be called advanced post telegraphs Each installation generally contains 1 kilometer of cable, which enables lines 2 kilometers in extent to be filled up between two stations.

At the time of the discovery of the telephone, it was thought that this new instrument was destined to take the place of these telegraphs. But the experiments during the Russo-Turkish war soon showed that the noise of an army almost always, except in the silence of the night, prevents the voice from being heard. The most perfect telephones were, however, known at that time, those constructed by Siemens, at Berlin, and by Gower, at Paris.

The microphone even does not amplify the sounds sufficiently to render them perceptible under all conditions. It requires a battery, which is cumbersome and necessitates a certain regulation of position in relation to the vertical, which is inconvenient. Finally, it must be placed on a fixed stand, for it produces deep sounds when vibrations are communicated to its support. It has, therefore, been rejected altogether; as to the telephone, it has been admitted that under certain conditions it can be of service, and in the greater number of armies it has been added to the light telegraphs already in use. The following are some of the different systems:

A.—SYSTEMS WITH PERMANENT SIGNALS.

I.—*The Prussian Telegraph of Bückoltz*, employed by the Company of Belgian Campaigning Telegraph Operators. This apparatus has a return wire and is worked by a continuous current—*i. e.*, when there is no transmission—the current passes through the line and gears the clockwork mechanism; the signals are then produced by the interruption of the current, which throws the mechanism out of gear. Consequently, directly the cable is cut, the operators become aware of it.

The instruments work together—*i. e.*, the dispatch is recorded simultaneously at the two stations. A recent improvement enables us to pass from the continuous current to the ordinary current by means of a commutator.

A complete installation comprises:

1. A case 0.15 m. × 0.14 m. × 0.15 m. containing the galvanometer and the manipulator. The last model is somewhat larger.

2. The battery, consisting of 12 Siemens elements with sulphate of copper. It weighs 12 kilogrammes.

3. Two coils of 500 meters of cable with two wires, one carried in a sort of infantry bag, the other in a case.

II. *The Russian System of Dereviankine* is very similar to the above: the earth is employed as return conductor.†

Remarks.—The field telegraphs of Buckoltz and Dereviankine are the only ones that give permanent signals. They are excellently arranged; we think it would be impossible to condense any further the component parts, which are essential if we wish to keep copies of the dispatches; but this does not seem to be altogether necessary. In America, on almost all the permanent lines, the dispatches are sent by sound alone, and in campaign telegraphy it is very seldom that important orders are transmitted of which it is necessary to keep a copy.

B.—SYSTEMS WITH MOMENTARY SIGNALS.

a. Optical Telegraphs.

I.—*Trouve System.* This is only a miniature, about the size of a large watch, of an ordinary dial telegraph, with simplified mechanism. The receiver is worked by clockwork; the manipulator is worked by a button similar to that in keyless watches. The wet battery and a kilometer of cable are placed on a yoke to be carried on a man's back.

II.—*Wheatstone One-Needle System* (in use in the Spanish army). It comprises as a receiver a vertical galvanometer, the needle of which deviates to the right or to the left, according to the direction of the current transmitted. The deviations to the left form the dots, and those to the right the dashes of the Morse alphabet. The manipulator, which resembles all those of the Morse type, is worked by reversals of the current; it is placed above the galvanometer, which is only eight or nine centimeters in height.

III. — *Prussian Needle Telegraph, with Earth Battery.* This system is similar to the preceding one; the current is supplied by two pieces of zinc and copper, which are buried in the damp earth. It was used during the war of 1870.

Remarks.—The Trouve system is very delicate; the two others are more solid and better suited to military operations. But it is very difficult to read the Morse signals indicated by a needle, and it cannot be used at night. As a sound can be heard at any time, sounders are preferred to the above instruments.

B.—SOUNDERS.

I.—*The Caton Sounder* (employed exclusively in the military telegraph of the United States). It is simply an electro-magnet, the armature of which forms the sounder. It is contained, together with the manipulator, in a little case, 0.15 m. × 0.06 m. × 0.04 m.

The battery employed contains several elements with sulphate of copper.

II.—*The Sounder of the French Army*, smaller in size, but similar to the preceding one, employs a wet battery or a reversible one.

III.—*Dereviankine's Russian Sounder*, also similar to the Caton sounder, is only 0.10m. × 0·08m. × 0·05 m.

IV.—*The Spanish Sounder*, with dimensions similar to those of the French sounder.

V.—*The Trouve Sounder* has the appearance of a large watch. The accessories are the same as those of the portable telegraph by the same inventor.

Remarks.—All these sounders have the inconvenience of requiring a somewhat powerful and consequently cumbrous battery. The Trouve battery is the lightest, but the apparatus worked by it has rather a limited value. At the time when it was shown by experiment that the telephone was of little use to reproduce speech at the vanguard of an army, it was found that under the influence of battery currents, and especially of the high-tension currents of induction coils, this apparatus gave sounds of great intensity. When a current is sent into the circuit of a telephone, the magnetism of the magnet which constitutes it varies, and the result is a variation in the action of this magnet on its diaphragm of soft iron. Two different sounds are then heard, one when the current is established, the other when it ceases, and thus long emissions can be distinguished from short ones, as in the Morse sounder.

In order to produce a sound of greater intensity, serving to warn the correspondent that the transmission is about to commence, the interrupted current of a little Ruhmkorff coil is employed; a continuous current can also be sent into the line, the interruptions being produced by the plate of the telephone itself, by arranging it like the armature of a trembling bell. (Captain Ferrodon's alarm.)

The instruments constructed according to the above principles are:

C.—TELEPHONIC SOUNDERS WITH BATTERY.

I. — *The Racagni-Guglielmini System.* —These inventors arrange their induction coil either in the handle of one of the telephones, which also contains the manipulator, or on the reversible battery, which has the form of a cartridge-box. They employ an electro-chemical receiver with paper hand, which seems to have the drawbacks of the Morse system without possessing its advantages.

I.—*The Mangenot System* is identical in principle with the preceding one. The battery is also in the form of a cartridge-box, and contains the manipulator and the induction coil. The inventor, acknowledging the inconvenience of his battery, which is never hermetic and which becomes polarized, proposes to substitute for it a Clarke machine, weighing 2.5 kilos. In the event of its being impossible to hear sounds, he proposes to receive by the sense of touch, by placing the lips on the terminal of connection of the telephone. It will be remembered that a very skillful telegraph operator in 1870 received a message in this manner across a cable submerged under the Seine; but this was really a feat which would require no common degree of skill to perform.

Remarks.—All these instruments have the drawback of requiring cumbrous batteries, which the slightest accident would render useless, and which require great care. M. Mangenot proposes to substitute for them an induction machine, which is too heavy and which presents the great disadvantage of requiring a man to turn the handle. The solution of the problem must evidently be sought for among the following instruments:

D.—TELEPHONIC SOUNDERS WITHOUT BATTERY.

I.—*Colonel Jacobi's Telekal.* The complete installation comprises a long-distance telephone, and a case 0.21 m. × 0.11 m. × 0.33 m., weighing from five to seven kilos., and called the *Telekal.* It is furnished with a Morse manipulator, worked in the ordinary manner. By means of a little handle, the manipulator can be made to ring so as to call the correspondent.

We can also employ for this purpose the trumpet call with which long-distance telephones are supplied, whether constructed by Siemens or by Gower.

The advantages of the telekal are, according to the inventor, that it can be worked without battery to considerable distances, far beyond the limit at which the voice can be heard, without being affected by the telegraphic transmissions of neighboring wires or external noises It requires no regulation of position like the microphone, and is of great solidity.—*Electrical Review.*

* "La Telegraphie Electrique de Campagne." By Van den Bogaert, officer of the Belgian Engineers.
† Paris Exhibition of 1881, No. 1,700 in the catalogue.

The Electric Light in Conservatories.

(*Translated for the* REVIEW *from La Lumière Electrique.*)

During the International Exhibition of Electricity of 1881 there was in the grand nave of the *Palais de l'Industrie* a little enclosure in which M. Dehérain undertook to experiment on the influence of the new illuminant on the growth of plants, and we have had a few words to say on the subject of these experiments in our number of May 6th, 1882. But no serious inferences were drawn from the experiments made at that time, because the conditions were unfavorable, the installation insufficient, and the duration of the observation too short.

The small garden of the Exhibition could contain only a very restricted number of plants, which were in an atmosphere badly adapted to furnish them with the necessary elements of vitality. Outside of the electric light, which was only turned on during the night-time, the diffused light reaching the sort of glazed show-case in which the plants were enclosed, itself enclosed by the glazed roof of the principal nave, was very imperfect. The rays of the sun could never reach the unfortunate plants, which, having for their sole resource a few hours daily of exposure to the electric light, decayed day by day, and had to be replaced as fast as they withered, in order to hide from the public the effects so contrary to what were generally admitted to be possible.

There have been, however, other experiments than those which we have just described—experiments repeated several times and skilfully conducted by botanists and electricians. They have been carried on in large conservatories, in which the electric light could be adapted to all desirable trials, the other conditions of aëration, of temperature, and of diurnal illumination being conveniently arranged, while plants of different species and varied dimensions were submitted to the constant examination of the observers.

We have in mind one of those conservatories, in which there were specially accumulated a number of tropical plants, for the purpose of studying the effects that the electric light, succeeding that of the sun, could produce on all the shrubs habituated to the dazzling light of the regions to which they were indigenous, but with the same conditions of intermittence of night and day which exist in nature.

We find among the names of the scientists who have elucidated the question of the development of plants, under the influence of either natural or artificial light, those of Messrs. Darwin; Schübeler, of Christiana; Gilbert, F.R.S.; Stokes, J. W. Draper, and C. W. Siemens; and the latter, in a lecture delivered some time ago before the British Association, has described some of the details of that experiment.

The conclusion to which Mr. Siemens has arrived can be summed up by saying that the electric light can produce on plants effects comparable to those of solar radiation; that chlorophyl is formed under the electric influence, and that we can by this means obtain the development of flowers and fruits of rich colors and exquisite flavor.

In the experiments to which we now allude, it has been noticed that the interposition of a thin plate of perfectly transparent glass between the electric arc and the plants under observation produced a very striking difference in the results obtained.

The screen described was placed before the light in such a manner as to allow only a portion of the rays to pass through it, and it was remarked that, during the lapse of a single night only, the line of demarcation between the rays received direct and those passing through the glass was plainly visible on the leaves.

That portion of the leaves which received the rays from the naked light, although from nine to twelve feet distant, were noticeably wrinkled, while that portion receiving the light passing through the transparent glass were found in a perfectly healthy state, and seemed to flourish. Every leaf indicated these results. Not only the leaves, but the young shoots very soon showed signs of injury when they were exposed to the naked electric light, and they were attacked, although less energetically, at a distance of twenty-four to thirty feet. This subject has vividly excited the interest of vegetable physiologists; and Professor Stokes, among others, has demonstrated that the arc light is found to be particularly rich in very refrangible, invisible rays when the spectrum is examined, and that these are largely absorbed in passing through the transparent glass. It therefore appears logical to admit that these rays have a destructive action on the vegetable cells, whilst the less refrangible luminous rays stimulate organic action.

Care should be taken, in conservatories which are illuminated by the new process, to humor this sensitiveness of plants by means of transparent glass globes placed around the arcs, with the two-fold object of confining the chemical products of the light and of forming a screen between the arc and the plants submitted to its influence.

C. C. SOULAGES.

An electrical exhibition will be opened next winter in Madrid.

Telephonic.

THE TELEPHONE IN SOUTH-EASTERN MASSACHUSETTS—BOSTON GOSSIP.

Massachusetts, the native soil of the Bell telephone, the scene of the Professor's first experiments and earliest triumphs, the nursery of long distance transmission, the present home of the American Bell, the center from which emanate the welcome responses to "exchange account orders," and in which all decrepit "Berliners" and "pony crowns" are finally absorbed, has led the way in the onward march of the new policy of consolidation. Every telephone man the country over knows by heart the names of the "triumvirate" whose original investment at Lowell in the early history of matters telephonic, was followed by the acquisition of one city after another, then the absorption of other companies, and finally of other States, until now it may almost be said, as of the rich real estate proprietor, that they own all the land that joins them. In fact, after the amalgamation of the Boston and Northern, Bay State and Suburban companies, representing 6,445 subscribers March 1, little Massachusetts territory remained outside of Boston, but Plymouth, Bristol, Barnstable, Nantucket and Dukes counties.

Glancing for a moment at the

TELEPHONE DESPATCH COMPANY,

whose system was so long the American Bell's laboratory for the trial of various and sundry experiments, the visitor finds, as the members of the convention did last fall, that Boston now deserves the name of possessing one of the finest working exchanges in the country. This result is due in great part to the intelligent systematizing of Mr. G. L. Phillips, lately appointed assistant general manager of the American Bell Company, with headquarters at Chicago; the energetic business foresight of manager H. B. Lytle; and the almost sleepless vigilance and originality of W. D. McKinney, who came with Mr. Phillips from Dayton, O., a thorough operator with his eyes wide open. In rising to the position of superintendent recently, Mr. McKinney, let his mantle fall upon a worthy successor in the management of the operating department, John J. Carty, who fully sustains that trying and vital portion of the company's work. Probably 1,500 subscribers are now connected with this office, and from recent newspaper statements it would appear that more or less of the number are talking through a quarter of a mile or so of the Day and Phillip's cables which, as is well known to Boston people, have recently been laid in the underground tubes commenced last fall. About three weeks ago a rising reporter of the Boston *Advertiser* evolved from a general conversation upon electrical subjects with some of the affable people of the office, from his own evidently very limited electrical knowledge, and from a vivid imagination, the thrilling statements that the underground system is a great success, and that the subscribers in general are being rapidly attached through the media of the new cables. Again, a short time since, Lieut. Green of the U. S. Engineer Corps, at the instance of the commissioners of the District of Columbia, visited Boston to inspect the workings of the new plan. It is to be presumed that he obtained admission to the upper apartment, feasted his eyes upon the aggregation of female loveliness and efficiency by whose aid the machinery of the system is kept smoothly running, exclaimed "wonderful!" as he gained the landing of the tower above, speculated inwardly as to whether the ideas of the great "unwashed" got mixed as they mingled in the maze of wires above the section cables of the switch-board, noted that the conductors from the underground channels made their way to lightning arresters before they reached the operators, looked down a man-hole in the street below, and then wrote out an elaborate report which was published by the associated press, declaring the whole project to be not only feasible for Washington, but an unqualified success in Boston. Probably testimony of this kind may carry a bill through Congress. The reticence of the officers of the Boston company is reasonable and proper, and you will doubtless be informed of the real results of these tests by your competent and ever-wakeful correspondent "T. D. L.," as early as any careful and official deductions are given to the public.

The "extra territorial" traffic, which centers in Boston, is now very large and constantly increasing. Three years ago four or five wires did all the business outside the exchange. Now about 75 trunk lines come into the office, and eight or ten of the operators at the thirty Gilliland tables are more or less occupied in watching "long line business." Boston talks with ease much farther than New York. There we were told the other day that it was with the greatest difficulty that Newark could be understood. Here Providence, Worcester, Fitchburg and Manchester, N. H., forty and fifty miles in different directions, are ordinarily heard fairly well, and tests are made in quiet times from Worcester through Boston to Brockton, Taunton, and Fall River, sixty to one hundred miles, with good success.

BROCKTON,

twenty miles south of Boston, was one of the earliest places to adopt the telephone. The first lines were run in March, 1878; an exchange system was established in January following; a corporation took charge of the business in March, 1880, under a five years' contract; the spring of 1881 saw a thirty-foot line completed to Boston, which has proved one of the best and most reliable trunk routes in New England; in August, 1882, the stock of $17,000, which had been divided among upwards of fifty holders, was purchased by G. C. Tobey of Wareham, and S. A. Williams of Boston, and soon transferred to A. P. Sawyer and G. W. Piper of Newburyport, the former head and front of the Suburban Company; and within the past fortnight the interest has passed to the Southern Massachusetts Telephone Company, who now control the four counties mentioned at the outset. The Brockton Company, who covered only four towns with an aggregate population of from 28,000 to 30,000, will now be dissolved, being in the condition of the Inter-State Company at its demise, having "no property and no liabilities." The exchange, branch, and extra-territorial wires have connected eleven towns, including twelve public stations, and one hundred and sixty subscribers, and embraced forty-five miles of wire on poles and thirty miles on housetops.

THE SOUTHERN MASSACHUSETTS

interests are presided over by C. W. Clifford, president; Samuel Ivers, treasurer; Moses E. Hatch, general manager; all these gentlemen being of New Bedford, where the office of the company is situated. Perhaps it is not known, outside those especially interested, precisely what number of subscribers are connected with the lines, but probably about 1,500 may be counted in New Bedford, Fall River and Taunton, beside those added with the new Brockton district. Nearly fifty towns are reached by the widely extended lines, covering Bristol and Plymouth counties and the Cape. Through the latter section, the "right arm of the commonwealth," lines were carried rapidly last season, and the sandy shores of Provincetown will probably send salutation to the oily piers of the "Whaling City" before snow flies next fall. All the prominent points in this company's territory have been in communication with Boston and Providence for two years. The officers, though perhaps less widely known than some others in New England, are among the most careful and sagacious, and are highly esteemed throughout the circle of their acquaintance, illustrating their thorough confidence in the future of the business by the magnitude of their personal investments, and the quiet, non-sensational method of conducting their rapidly increasing business.

NOTES.

The telephone capitalists of Massachusetts are wide awake to the advantages of consolidated interests in other sections. Aside from the recent purchase of Minnesota and the Northwestern Company by the Lowell Syndicate, H. B. Lytle, of the T. D. Company, and A. P. Sawyer and G. W. Piper, late owners of the Brockton property, are among those who lately obtained a controlling interest in the Washington, D. C., organization.

W. J. Jenks, who was the promoter and manager of the Brockton company, resigned March 1, to accept the management of the Edison Electric Illuminating Company of Brockton. His place has been taken by E. C. Coolidge, formerly in the office of the Telephone Despatch Co. It is reported that Mr. Coolidge will retain his position under the new management.

The historic town of Plymouth was one of the first to introduce the telephone, and a circuit of perhaps a half dozen stations, for social purposes, is now in operation. Until a short time ago, it was equipped with the original wooden receivers, which few of the younger managers of to-day have ever seen. No Blake transmitters have yet been introduced. A line will be built this season, connecting with Brockton, and thence with Boston.

INSPECTOR.

Boston, March 31, 1883.

On Thursday the experiments in talking between New York and Chicago by telephone were continued over the lines of the Postal Telegraph Co. The Chicago instrument was at the Stock Yards, a few miles out of the city, the distance between the two telephones being about 940 miles. The telephones used were made by Edison nearly four years ago, and were found to work better than the ordinary Bell instrument. In place of the Leclanché cells, two Grenet cells were used in connection with detached induction coils. When the instruments were adjusted, conversation was carried on by different persons with varying success. Mr. Scribner, who was at the Chicago telephone, was very distinctly heard here, but he did not appear to hear, except with much trouble, what was said in New York. It will require a series of experiments to determine the best instruments and methods of working upon this long line.

Annual Report of Bell Telephone Co.

We publish herewith a summary of the report of the American Bell Telephone Company, held in Boston on the 28th ult., the following officers were chosen for the ensuing year:

Directors—Francis Blake, Charles P. Bowditch, Charles S. Bradley, George L. Bradley, Channing Clapp, Alexander Cochrane, Wm. H. Forbes, Charles Eustis Hubbard, Gardiner G. Hubbard, Robert B. Minturn, William G. Saltonstall, Thomas Sanders. Treasurer—William R. Driver. Clerk—Charles Eustis Hubbard.

It was voted to increase the capital stock from $7,350,000 to $9,800,000 by the issue of one share of new stock for every three of old; to authorize the trustees to apply such amount of stock as is necessary for the conversion of the $500,000 notes issued in 1880; to amend the by-laws so as to permit the holding of the annual meeting anywhere in Boston, instead of exclusively at the company's office The latter is too small to accommodate a constantly increasing list of stockholders. The annual report of the directors was presented in writing, and from it these facts were gleaned, showing the rapid growth of the company:

	Jan. 1, 1882.	Jan. 1, 1883.	Increase.
Exchanges in operation	486	735	249
Subscribers	70,525	97,735	27,210
Miles of wire	49,168	69,452	20,284
EXTRA TERRITORIAL LINES.			
Licenses issued	75	256	181
Miles of pole lines	2,007	6,154	4,147
Miles of wire	3,037	13,653	10,616

There were under rental February 20, 1882, 189,374 instruments, and February 20, 1883, 249,711, a gain of 60,337. The instruments manufactured and purchased up to February 20 numbered 328,528, and were thus accounted for:

In hands of licensees, 249,711; on hand available, 13,940; destroyed, 20,722; defective to be destroyed, 40,966; balance in suspense account, 3,189.

It was noted that the income from the interchange of telegraph business is double that of the pevious year, although this branch has not yet assumed large proportions. The profits on the sales of instruments have decreased, foreign manufacturers having at last succeeded in making good telephones for their own countries. The reports from the local companies throughout the country are considered encouraging, many of them paying dividends. The underground wire experiments had thus far proved successful for short distances only.

Regarding the People's Telephone suit, a letter from Messrs. Chauncey Smith and James J. Storrow briefly states the present status of the case, and reaffirms the opinion of last year, in substance that there was nothing to fear in that direction. To secure further holdings in companies acting under the Bell license, there was expended beyond the amount previously provided for the purpose, $1,750,000, which was met by temporary loans. To make permanent provision for this, and to furnish a fund for construction, etc., the increase of the capital stock was recommended.

The statement of the Treasurer for the year ending February 28 was as follows:

	1881-2.	1882-3.
EARNINGS.		
Rental of telephones	$885,312 92	$1,257,054 58
Sales of instruments and supplies	40,935 89	27,633 37
Royalties from manufacturers	8,193 95	2 51
Dividends	56,742 00	262,385 56
Commissi'n from extra territorial and branch lines	4,932 27	17,073 61
Commissi'n from telegraph business	5,807 38	10,736 97
Miscellaneous earnings	....	1,144 97
Totals	$1,001,924 41	$1,576,031 57
EXPENSES.		
Expenses of operation	$116,632 27	$145,991 31
Legal expenses	78,121 03	112,688 41
Interest and taxes	43,198 71	72,350 56
Depreciation	21,502 53	24,357 45
Commission (royalty to the Western Union Telegraph Co et a.l, contract of November 10, 1879)	180,408 22	246,821 76
Royalty	....	1,777 80
Totals	$439,862 76	$603,987 29
Net earnings for the year	$562,061 65	$972,044 28
Balance of income from previous year	44,493 36	126,034 58
Totals	$606,555 01	$1,098,078 86
Dividends paid	$416,500 00	$595,000 00
Carried to surplus account	64,020 43	334,997 32
Balance of income account	126,034 58	168,081 54
Totals	$606,555 01	$1,098,078 86
ASSETS.		
Patents		$3,399,832 60
Telephones		417,364 10
Stocks and Bonds		7,828,851 60
Merchandise		18,757 14
Manufacturing property and underground construction		141,467 79
Bills and accounts receivable		125,941 75
Cash and deposits		19,937 33
Total		$11,952,152 31
LIABILITIES.		
Capital stock		$7,350,000 00
Loan of 1880 (convertible)		500,000 00
Loan of 1882 (convertible)		645,000 00
Bills and accounts payable		1,806,986 33
Income account		168,081 54
Surplus account		399,017 75
Reserve account		1,083,066 69
Total		$11,952,152 31

The principal streets of the city of Alcamo, in Sicily, possessing over twenty thousand inhabitants, are about to be lighted by the incandescent system.

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CONTENTS.

	Page
Experiments with a new Electrical Street Car	1
The Electrical Exhibition	2
Dentistry and the Electric Light	2
The Future Economical Generation and Storage of Motive Power	2-3
Electric Motors	3
An Engine Running Incessantly 16 Days	3
Mica Prisms	3
Atmospheric Electricity	3
Transmission of Power by Electricity	4
Storing Electric Energy	4
On the Corrosion of the Copper Plate in the Daniell Cell	5
Electrical Items	5
Field Telegraphy	6
Telephone News	6-7
Water Gas	8
Economy of the Electric Light, by Prof. P. H. Vanderweyde	9
Miscellaneous News	10-11

Water-Gas.

Not long since, when the public was complaining more bitterly than usual against the extortion of the gas people, of the unhealthfulness of their fluid, various companies sprang into existence with the expressed purpose of manufacturing what is known as water-gas. About the same time a monthly journal appeared representing the interests of this particular description of gas—or, rather, more than representing this interest—for its columns are apt to contain assertions respecting the extraordinary qualities of this gas that doubtless its editor is not at all times prepared to sustain. Nevertheless, we like to see zeal in journalism, as in everything else, and we read this journal with great interest. From the very start we were assured that this water-gas was the illuminant of the future; that it was not only going to supercede electricity, but would in the near future leave its rival—carburetted hydrogen gas—so far in the rear as to baffle the powers of the most gigantic telescope to find a trace of it remaining. We will not deny that we experienced a sensation of satisfaction when we heard this from such an authoritative source; for we have always believed that, aside from being very expensive, this carburetted hydrogen gas is unhealthful, destroying as it does the most necessary constituents of that air which it was intended we should breathe pure, and leaving in their place sulphurous fumes and other and more poisonous odors.

It was, therefore, as we have said, with a feeling of satisfaction that we heard that, if we couldn't have electricity to light our dwellings, we could at least have water-gas, and that this fluid was rapidly taking the place of the abominable stuff with which most dwellings are now lighted. Taking the assertion of the water-gas journal *au serieux*, we climbed up into the topmost window of our editorial sanctum, and obtained a position where we could see the great gas monopolies break up their plants and transfer their mains from the street to the junk-shop. But singularly enough, and notwithstanding the assertion of the water-gas paper, the gas people didn't seem to be alarmed to any great extent. They seemed, on the contrary, to be as intently engaged in their little game of hoodwinking the public as ever, and the millennium that we were promised didn't come to time.

So we took up our water-gas paper again in hopes to find the reason for this delay on the part of the gas people in resigning in favor of water-gas, but not a word of explanation was there. We began to lose faith in the promises of these water-gas people, and an incident of recent occurrence has, we regret to say, given us reason also to lose confidence in their gas, though, doubtless, the water part of it is good—we are ourselves in favor of water as a beverage, but not as an illuminant.

In Brooklyn, the other day, Alderman Houghton presented a preamble and resolution, in which he asserted that water-gas contained a large percentage of carbonic oxide, which is a rank poison, and he called upon the Health Commissioners to cause an analysis to be made of this water-gas, Eight deaths, it is alleged, have been traced directly to this cause within two years.

Water-gas or naphtha gas is hardly so bad as the cholera or small-pox; still, if a single death can be traced directly to it, householders will do well to look closely after their burners or leaks in the meters, and the companies to their methods of manufacture.

Major G. W. La Rue of the Delano Haines Company, of the city of Mexico, is making a brief visit in Cincinnati and New York. The Major is one of the best linguists in the country, and it would be difficult to find a gentleman who could relate as many interesting anecdotes and startling incidents connected with life in Southern countries. We think the Government at Washington would do well in appointing a gentleman who is so deservedly popular in our sister republic to some prominent position in the diplomatic service there. The company of which both Mr. Wiley (our esteemed correspondent), and himself are now members, have reason to congratulate themselves on the marvelous success already attained in the prosecution of their business in Mexico by these gentlemen.

The new mills of Messrs. Sabin L. Sayles & Co, at Killingly, Conn., will afford some electric light company an opportunity to put in a large plant. The dimensions of the new works are 200 × 50 feet, four stories, with various smaller buildings adjoining, all fitted up with the latest improved machinery. It is the intention of the owners to light by electricity.

Experiments with electric lighting are being made on the trains on the railway between Brussells and Antwerp.

Electrical Bubbles.

It would seem to be within the province of a journal devoted to the interests of electricians and their patrons to warn its constituency against wild and extravagant schemes, set afoot, usually, by those more at home in manipulating worthless securities than in developing to a successful issue crude mechanical contrivances.

Many an honest mechanician, schooled in the workshop rather than in the stock market, has been led to embark the result of toilsome years in futile attempts to transform what was a successful laboratory experiment into a commercial bonanza.

Our attention has been called to many such instances, and we have at hand a list of electrical ventures, in which we are, naturally enough, more directly concerned, that could only have been initiated by dreamers or knaves. At no distant day, we shall, representing the interests of those whom it is our bounden duty to protect, tear off the lamb's skin that covers the limbs of these devouring monsters, and exhibit to the light of day the insatiable wolves beneath.

We do not wish to be understood as charging that all electrical schemes that do not come up to the sanguine expectations of their authors are necessarily fraudulent. On the contrary, we know of companies that have been organized with a reasonable hope of ultimate success, but which, through causes which could not be anticipated, and by reason of obstacles over which their projectors had no control, have come to naught.

We will take the case of a man who finally succeeds in discovering what he takes to be a new principle in mechanical science. In the laboratory or the workshop, under favorable circumstances, he meets with a measure of success. Over-zealous friends advise him to form a stock company, in order to enable him to work on a large scale, looking to a great commercial success. The company is organized, and many persons, unfamiliar with the subject in hand, or prompted by unwarranted representations of future gain, are led to invest their money in the undertaking.

Now, the ambitious inventor sets himself to work to overcome the few obstacles which will result in accomplishing his object. Soon he discovers that one inquiry, one experiment, only gives occasion for another; that to search is not always to find, and to find not always to be informed, and that thus to pursue perfection is, like the first inhabitants of Arcadia, to chase the sun, which, when they had reached the hill upon which it seemed to rest, was still beheld at the same distance from them.

The Keely Motor fiasco is another instance of the kind. Large sums of money have been lost by innocent investors to enable this man to pursue his chimera, and, singularly enough, though he has never yet accomplished anything tangible, but on the contrary is continually failing to do in public what he declares he has done in private, the poor lambs already despoiled of their wool, rush eagerly forward to be clipped to the pelt.

Verily, the gullibility of some people is extraordinary. An inventor issues from his workshop, blows loudly upon his horn to attract attention, and then tells of the great things he is going to do in the future. Thereat a host of the credulous pack up their money bags and follow eagerly in his wake. So runs the world.

The Electric Cat.

The conflict which has so long been maintained between what are known as the "Regulars" and the Homœopaths has led to the discovery of natural processes that are likely to prove of great value to the human race. While experimenting with live animals in the attempt to overset the theory of *similia similibus curantur*, those of the orthodox faith have stumbled upon truths which heretofore had not dawned upon the apostles of either faith. We have at present to do with but one of these, determined by one who is at once a physician of the regular stripe and an electrician. It is that the cat is a complete magneto-electric apparatus, neat, compact, often beautiful, fairly safe to handle, and essentially harmless save when the baby excites an adverse current by rubbing its fur the wrong way.

The dog and the cat are not credited with wasting upon each other a superabundant order of affection. On the contrary, so far is the converse believed to be true that married couples who have ceased to live in a state of tranquility are said to lead a cat-and-dog life.

That all this is a mistake; that the instincts of both these animals have been misunderstood, we are enabled, owing to recent disclosures, to make known to an expectant world. Not Hermia and Helena are more beautiful instances of mutual devotion.

Who has not read the story that has been going the rounds of the press of the remarkable instance of an aged St. Bernard who sits for hours affectionately stroking with one paw and then another the neck and back of a neighbor cat. But the electro-medical discoverer to whom we have referred, and who, by the way, must be at the same time a heartless cynic, explodes this pathetic story.

It is well known that dogs especially are troubled with rheumatism—in fact, that most of them die of this malady. Now, the scientist in question says that the St. Bernard dog in the story was in the habit of stroking the cat's back not by reason of his affection for her, but was simply treating himself to an application of the electricity which he, like his brother-canines, had discovered is to be found in every well-organized cat's fur. Indeed, he asserts that the intimacy which is begun by a series of snarls and sputtering between the giddy pup and his neighbor the cat ripens later on to a mutual good-fellowship at advanced age, when the dog, a martyr to rheumatism, discovers beyond peradventure a sure panacea for his ills in the electrical deposit in the cat's back.

Even in this advanced age when one great innovation treads rapidly upon the heels of its predecessor, this discovery may be ranked with the proudest achievements of the day. It gives us a still greater admiration for the medical knowledge of the dog which, indeed, many biped physicians might envy.

It makes the cat also the central figure in a sphere of usefulness hitherto unsuspected, and adds still greater lustre to the triumphs of electricity that have so recently astonished the world.

If it is a fact that rheumatic dogs are greatly benefitted by using the cat, why may not men, following their example, receive a like benefit?

Again, the cat has been found to be a complete magneto-electric apparatus so harmless that even the small boy may play with it without serious result, which he could never do with the cumbrous and dangerous electro-magnetic machine.

When the knowledge of this valuable discovery shall have become thoroughly known, the cat, when she curves her back and rubs, purring meanwhile, against the legs of her master or his friends, will not, as is often the case, be roughly thrust aside. On the con-

trary, it will be taken as an evidence that she is desirous of assuming the rôle of a new therapeutic agent for the amelioration of those ills to which humanity is unfortunately the heir.

Let every family provide itself with a cat-battery.

A meeting of the New York Electrical Society will be held in its rooms, corner Greenwich and Liberty streets, at 8 P. M., Friday, April 6th.

Mr. F. W. Cushing will describe the latest developments in harmonic telegraphy, and a paper on "Cable Testing," by Geo. A. Hamilton, will be read.

Both of these subjects were postponed from last meeting owing to the lateness of the hour at which the election of officers was completed.

On Friday, April 20th, the society will meet at the Stevens Institute of Technology, Hoboken, N. J., when Prof. Henry Morton will address the meeting on the "Storage of Electricity."

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We regret to see that in England the old, white-beard argument as to who invented the telephone is being revived, and the discussion, as if growing with what it feeds upon, seems to be more virulent than ever.

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We are the more surprised at this because we have always been under the impression—possibly without reason—that the English only looked back over claims far enough to ascertain at least to their own satisfaction that what had proved an important invention had been discovered by an Englishman, and that that sufficed them—which particular Englishman being of no consequence.

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Doubtless Reis, to whom they credit the invention of the telephone, was groping around in the dark, as much as twenty years ago, for something that would, through the agency of electricity, carry the human voice between two distant points. We are told, however, upon good authority, that what resulted from his efforts "could not articulate, and, in the principle of construction adopted by him, it never would have articulated except by accident." This being the case, we do not see how his friends can claim the telephone for him; and, as the other Englishmen who have put in their claim for the same thing did not succeed in doing even so much, it would seem as though the grounds upon which they base their claims were still less tenable.

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The confidence of the public in the stock of the Bell Telephone Company was demonstrated the other day in a way that, to those who are unfamiliar with the amount of dividends paid by this company must have seemed extraordinary. The company declared a subscription privilege, allowing shareholders to subscribe for one new share at par for every three shares which they held. Singularly enough, this announcement, instead of depressing the stock, as might have been expected, since it came, too, almost upon the heels of the organization of what, to all appearance, was to be a dangerous rival, had an altogether different effect. The stock, which had been ruling at $280, immediately rose to $299.

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We hear little of the use of electricity in the coal mines—I mean, of course, the incandescent system—yet probably none are so greatly indebted to electricity as those who work amid the dangerous and inflammable gases which lurk in the bowels of the earth.

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In Cornwall, not long since, the miners made quite a demonstration in appreciation of the electric light that had been furnished them by M. Mangin. In order to prove the safety of this lamp, Mangin recently placed it in the middle of a balloon filled with hydrogen. The application, I understand, consists of an incandescent lamp immersed in a glass globe containing water. It is further intensified by a copper casing, with a silvered interior and one or more strong lenses.

We were glad to see in the *Revue Electrique* that some one had at last succeeded in fashioning an economical electric lamp, in which the carbons are held apart by a spring when no current is passing. The current, when first started, excites an electro-magnet, which releases a clip and allows the upper carbon to fall upon the lower. The weakening of the magnets, consequent on shunting the current through the carbons, allows the spring to bind the clip and draw back the upper carbon to the proper distance. When the carbons burn away so as to greatly increase the resistance, this process is repeated.

(For the ELECTRICAL REVIEW.)

MR. EDITOR: I read with much interest the compendious and intelligent report of Capt. Greene upon the feasibility of placing electric light, telegraph and telephone line wires under ground.

The report is, to do it justice, the most complete statement of the case that has ever been produced from the pen of any one *not an electrician* upon this most important subject. Yet would it not have been more complete had an electrician of the highest rank been associated with Capt. Greene in his investigation?

Viewed from an engineering point of view, I have no criticisms to make upon the report; for, unlike Capt. Greene, I do not care to criticise and express opinions on a game "I do not understand."

Up to the end of the sixth paragraph of the said report, therefore, I have no comment to make.

The seventh paragraph, however, I may not pass unnoticed. It reads as follows:

"These connections were being made while I was there, and as soon as completed it was intended to put the underground line in use. Its feasibility is, however, not in doubt, as cables of this description have been in use for some time on the overhead fixtures, and they were very fully tried in an experimental line laid along the track of the New York and New England Railway about a year ago."

This paragraph is not even technically correct. No cable has ever been laid on the track of the New York and New England Railway for telephonic experiments.

A cable was laid on the Boston and Providence Railroad for such a purpose, and the experiments made therewith, while sufficiently encouraging to warrant further experiment, were not sufficiently so as to enable any one to pronounce upon the effect of a similar system designed for commercial and daily use.

The fact that it is customary to operate cables overhead carries no argument to one accustomed to deal with electrical difficulties and phenomena. For retardation, which is not a cause, but a result, and which will undoubtedly prove to be the worst enemy of subterranean telephony, depends upon the length and extent of surface of the wire, upon its proximity to the earth, and upon the nature of the insulating medium.

Messrs. Preece and Sivewright, in their work on telegraphy, also state that *one mile* of subterranean wire will show as much retardation as twenty-three miles of the same size wire suspended overhead.

Capt. Greene goes on to show that the two enemies of the telephonic circuit, "induction" and retardation, are both to be expected in underground circuits, and that the former is overcome at the expense of the latter. He is approximately correct in this statement, only instead of saying "completely overcome" with reference to the first trouble, he ought to have said "decreased" or "diminished."

The next few paragraphs are devoted to descriptions of the different cables employed in the Boston systems, and are substantially correct.

As a matter of fact, there is no longer section of telephone line now operated underground than about a quarter of a mile, and even with this short distance the articulation is manifestly defective, being of a sluggish and muffled character.

That one of the most necessary elements of a good working telephone wire is its ability to work well, not only throughout its own limits, but also when connected with a much longer line, say, for example, one of forty or fifty miles, has, we believe, escaped the observation of Capt. Greene.

Such, however, is the case, and such, unfortunately, is not the case with these buried wires. The defects in the articulation, exhibited where they are employed, are greatly amplified when they are connected through with other lines.

In the same issue of the REVIEW which contains the report of Captain Greene is a reproduction of a lecture of W. H. Preece, one of the most practical electricians of the age, and his remarks on this subject are so practical that we make no apology for citing them.

He says: "There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snowstorms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth, so that overground are, commercially, sixteen times better than underground wire."

T. D L.

Economy of Electric Light.

BY P. H. VAN DER WEYDE, M. D.

Any one who has traveled by night along the upper Mississippi River must have noticed the primitive way in use there to illuminate the landing places of the steamers; it consists simply in burning the bituminous coal so abundant there in a vessel made of straps of iron, and attached to the top of a long iron rod, thus forming a kind of torch, at the top of which about half a bushel of burning coal sheds a lurid glare, the combustion being very imperfect, as most of the coal is converted into smoke.

A great progressive step was made on this primitive way by the aid of chemical science, when, in the beginning of this century, it was proved to be more economical to convert the coal into illuminating gas, as it was seen that in this way much more light could be produced from the same amount of coal. Gas-works were erected in all large and at present even in small cities, at an aggregate cost of many millions of dollars, in which works coal-gas is produced on a large scale, illuminating not only river fronts and streets, but also private houses, and the convenience of the system has resulted in its general introduction over all the civilized world.

But before this chemical invention can celebrate its first centennial, physical science comes forward, and shows another more complex method to obtain the maximum amount of light from coal. It is a method which, in the most striking manner, demonstrates the truth of the recent doctrine of the co-relation of forces, as it is based upon the mutual convertibility of heat motion, magnetism, electricity and light.

This triumph of physical science is due to the discovery that even electric currents passing through coils can produce motion by the magnetic attraction developed in properly arranged van cores, so inversely the motion of such cores can develop electric currents in the surrounding coils. In fact the present dynamo electric machines are nothing but the old electromotors, in which in place of producing electricity by batteries and converting it into motion or power, motion or power is produced by steam engines or waterfalls, and converts into electricity. As already in the beginning of this century, Humphrey Davy had demonstrated how powerful a light could be produced by electric currents, it was very soon suspected that the electric currents so easily and cheaply obtained by the proper applications of power might be the cheapest source for powerful illumination, and the expectation was soon realized, while the flourishing condition of electrical illuminating companies is the best criterion to judge it, this roundabout way of using coal for the purpose of illumination is economical, or if true economy should not be found in the primitive bituminous coal torches used at the borders of the Mississippi. If practice had not demonstrated the fact, no one, even not a scientist, would believe that these various successful conversions of the fuel, would not each be accompanied with so much loss as to make the electric light very expensive, and to ruin all those who would undertake to furnish it at a reasonable price; especially as the first of these causes is that of burning coal into steam power had proved to take place at a theoretical loss of 60 to 90 per cent. Fortunately the next conversions, namely those of the motion of the steam engine into magnetism and electricity, and again the latter into light to be placed with a trifling loss, while evidently every future improvement in the steam engine will be of equal great advantage to those using power in general, and to those who convert this power into light, the latter promising to become the leading pursuit of the age. What indeed is more sublime than to re-develop the solar light and heat which ages ago has been stored up, not as commonly thought by the books in the solid coal or fuel, but which is stored up in the atmospheric gaseous oxygen, from which the so-called force liberates it, and so makes our nights as cheerful as the day. The latter can only be done by electric illumination, as the electric light is the nearest approach to sunlight at the command of man, only some flashes of certain chemical compounds excepted, which however, are of very short duration, while electric illumination is permanent and independent of oxygen either in the atmosphere or in the chemical compound.

That the electric light is the nearest approach to sunlight is also proved by its successful use for photography, which is now in operation in New York City, making the photographer independent of the variations in the daylight occurring at various hours, seasons and state of weather, which, especially in a foggy atmosphere such as that of London, England, is of the utmost importance, as, in fact, the photographers there have on an average only two or three favorable days per week, and of these only the hours near the middle of the day. This fact induced the son of the writer of this article, Major Henri Van der Weyde, who is a portrait painter, to establish some years ago a photographing establishment at No. 182 Regent street, London, where only electric light is used for all the operations, without exception, making him the pioneer in artistic electro photography. Thanks to his eminent success, he became the court photographer.

His process is a most striking illustration of the economy of electric light, as he uses no steam power, but a gas engine, by which he drives a Gramme dynamo-electric machine, consuming about thirty cubic feet of gas per hour, and producing an arc light, which, by help of a parabolic reflector, illuminates the sitter with a soft but so active light that a portrait is taken in six seconds. Now, the question arises, if this same amount of gas, thirty cubic feet, were consumed by a number of ordinary burners, say six five-feet burners, could a picture be taken by it in six seconds? Every photographer knows that this would be utterly impossible, and that the most sensitive preparations require as many hours.

Or, to look at the matter from another point of view, thirty cubic feet of gas per hour is, per minute, half a cubic foot, and in six seconds, one-twentieth of a cubic foot.

Question: Is it possible to make a photograph by means of one-twentieth of a cubic foot of gas? Answer: It may be possible by the addition of combustion promoting chemicals to increase the quantity of light; just as it is possible to increase the heat produced or the power by making an explosive mixture; but surely it is utterly impossible in the ordinary way of burning gas.

It is indeed strange that in place of burning coal directly, it is more economical to employ the roundabout way of placing the coal in a retort and heating it so as to transform its principal constituents into gas, and then, instead of using the gas directly, to burn it in a gas engine and generate power; then to transmit this power to a dynamo-electric machine, and transform it into mag

netism and induced positive and negative electric currents; then to pass these currents over a conducting wire, and then place on the circuit so formed a few carbon points, and by separating them cause a local resistance, by which the two opposite electricities, while neutralizing one another and apparently disappearing, are transformed into a more intense light and heat than it is possible to obtain from fuel used in the ordinary way of combustion.

The question may be raised here, how it can be possible that by such a roundabout way of consumption we can obtain more light from the gas than there is in it by direct combustion. To this we answer that the use of the common gas-jet is a most wasteful method to obtain the maximum light from it. It is well known that the luminosity of a gas flame may be immensely varied by the manner of combustion. If we let the gas escape from a great number of small holes, we can obtain only very little light by its combustion, while, inversely, we increase the light produced by a number of burners when we combine them so as to produce one single large flame in place of many smaller ones. When we mix the gas with air before combustion, as is done in the Bunsen burner, we rob it of almost all its illuminating power, while, inversely, when we blow a very small gas-jet with an air-jet upon a piece of lime, or, better still, on a piece of oxide of zirconium, a much greater amount of light is obtained. Still more light is produced when jets of gas and oxygen are used, in which case we have the well-known Drummond light, which, in regard to brilliancy, is next to the electric light. For the sake of practical simplicity, the lime may be omitted, and a jet of oxygen blown into the gas flame, which will largely increase its illuminating power. Some years ago Tessier de Motay attempted to introduce this system in New York City. It was found to increase the light produced by the gas to a very great extent; but the economy thus obtained was more than counterbalanced by the increased expenses of manufacturing oxygen, even while this was done in an improved and very economical manner. Another outlay was the necessity to furnish two sets of pipes to the houses and gas fixtures—one for the gas and one for the oxygen. The system was found too complicated and expensive, in comparison to the results obtained, and was abandoned. Since that time we have seen some other similar systems for increasing the luminosity of gas, but none of them better than the last mentioned; so that, after all, it appears that, of the known methods which science has furnished for economical light production from a given amount of fuel, the electric light stands foremost, and that, notwithstanding the apparent complication of the machinery between the furnace where the fuel is burned and the illuminating carbons of the arc light, or incandescent lamp, it is the most practical method thus far invented for the production of intense illumination.

The Mexican Telephone Company.

In response to the general inquiry for more definite information regarding the Mexican Telephone Company, we are able to lay before our readers the following report, which Messrs. Delano & Haines will make to the stockholders:

OFFICE OF THE
MEXICAN TELEPHONE COMPANY,
NEW YORK, March 26, 1883.

To the Stockholders of the Mexican Telephone Company:

On Dec. 15, 1882, the President of the Mexican Telephone Company issued a circular letter, giving facts, figures and prospects of the company, in which a statement was made that "unless some very unexpected contingency should arise, a dividend of 1½ per cent. would be declared April 1, 1883," and as that date is near at hand, it is necessary to make another statement, showing why it will be impossible to declare a dividend at the date mentioned.

Below will be found a few facts which may be interesting; and a very full statement, accompanied by figures, will be rendered at the next annual meeting of stockholders, to be held April 11, 1883, at the offices of the company, Temple Court, No. 5 Beekman street, New York.

After several unsuccessful attempts made by prominent telephone men in the United States and Mexico, and in the face of formidable opposition, Messrs. Delano & Haines agreed to accept the general management of the affairs of the company, furnish $100,000 for its development—viz., acquire the necessary patents, concessions and right of way; construct, equip and put into operation the telephone system in the City of Mexico. Their past large telephone experience in the United States led them to believe that the sum named would be ample for all requirements, and that it would be unnecessary to draw upon the earnings of the company for its further maintenance. Up to this time, no concessions had been granted, with the exception of one allowing the placing of wires under ground. For this right, the sum of $8,600 had been guaranteed by the parties from whom the Mexican Telephone Company acquired their contract, and was paid by Messrs. Delano & Haines, together with an additional sum of thirty-four thousand dollars ($34,000) paid for development before any stock was offered to the public.

To remove all known existing opposition, a further sum of eighteen thousand five hundred dollars ($18,500) was paid for material already on the ground, owned by an opposition company (at exorbitant rates), the parties agreeing to withdraw and forever remain out of the telephone business in Mexico.

The decrees since necessarily obtained from the General and Municipal Government have been the source of heavy expense. The above items, together with the necessary outlay of cash paid for wire, poles, telephone receivers, transmitting magneto bells, and other material, as well as for labor and development of additional territory, have exceeded the entire working capital by about six thousand dollars ($6,000), which sum was advanced by the managers.

It was deemed advisable to include the entire State of Mexico and adjoining State of Jalisco, to be owned by the Mexican company, the territory being decidedly the most valuable in the whole republic, and about seven thousand dollars ($7,000) has been expended thereon from the treasury of the Mexican company.

It has been suggested by holders of a large amount of stock of the Mexican company that the capital stock of the company be increased, in order to provide funds for further operations. In the judgment of the present management this step is unnecessary, as a loan can be obtained upon valuable stock owned by the Mexican company in its subcompanies, which are more than paying expenses at the present time, and rapidly increasing in value.

We would now mention some of the difficulties encountered in the establishing and operating of the exchange in the City of Mexico, which were unavoidable, and were overcome with no little expenditure of time and labor. As before stated, the only concession obtained was for underground wires. It was found to be absolutely impracticable to adopt this system, and a delay of six weeks was occasioned in obtaining the right to erect a pole line, and the material used in and the construction of the buildings precluded a possibility of fixtures on housetops.

In the privilege obtained for the setting of poles, it was stipulated that the height of poles should not exceed twenty-five (25) feet.

The only suitable building that could be rented at that time, to be used as an exchange, was secured, the owner refusing to give a written agreement as to the number of wires that might be carried into the cupola erected for their accommodation, but verbally assuring the general manager that an unlimited number could be run. After two hundred (200) subscribers had been connected, the lessee positively refused to allow any more wires to be placed upon the premises. To avoid litigation, which would be expensive and injurious, with doubtful results, it was decided to remove the exchange into more centrally located property, upon which a lease granting all necessary privileges was obtained. This removal necessarily caused a suspension of all new work, as the two hundred (200) subscribers had to be protected before adding new ones, on file. The new exchange was opened and one hundred and fifty (150) new subscribers connected.

At this time notice was received from the city authorities to the effect that they had previously granted the right of way along the thoroughfares to the gas company, for the erection of a line of poles to carry wires for electric lights, and a claim made that our wires conflicted with their privileges. They thereupon issued an ordinance demanding that all poles placed by us should be taken down at once, and informed us that our only chance was underground. All construction was thereby brought to a standstill, and immediate steps taken to obtain the right to replace the poles already in use by others of sufficient height so as not to in any way conflict with the wires of the electric light, which privilege was finally granted for a period of nine (9) years.

After much delay, and at a further expense, we now have all the rights, privileges and concessions necessary for the successful development of our telephone business in Mexico. In this connection, we would add that the sub-companies have not been, nor are they likely to be, embarrassed by any of the above-mentioned difficulties.

Owing to the dangerous and protracted illness of the resident general manager in the City of Mexico, he deemed it advisable to resign the position and return to the United States. The position has been accepted by Mr. George L. Wiley, who was vice-president and general manager of the Mexican Central Telephone Company, with headquarters in Leon, Mexico (formerly superintendent of the Metropolitan Telegraph and Telephone Company, of New York City), for the term of two years. The State of Jalisco is under the management of Mr. D. S. Hobart (formerly of Boston), with headquarters in Gaudalajara. The ability of these gentlemen is unquestioned, and their popularity in the Republic of Mexico fully established.

We are no longer dependent upon experienced and expensive help, heretofore sent from the United States, the education of the natives as exchange managers, inspectors and line-men having satisfactorily progressed, thus materially reducing operating expenses.

Before the decrees were issued, and in order to discourage opposition, it was considered to the best interests of the company to make the rental of the telephones two dollars ($2) per month for a period of six (6) months, at the expiration of which time it was increased to five dollars ($5) per month, and we take pleasure in stating that not a single subscriber was lost.

To obtain the decrees we found it absolutely necessary to secure the coöperation and good will of many prominent residents who had become to a *great extent* embittered by the questionable course previously pursued by certain parties, to the injury of the enterprise.

The statement hereinbefore mentioned, to be rendered at the next annual meeting, will cover everything in detail regarding the business of the company from its organization to March 1, 1883, and the managers respectfully request a very full attendance of those interested, as the meeting will be of the utmost importance.

Very respectfully,

DELANO & HAINES.

An ounce of coal represents an amount of energy which, if entirely expended in doing work, would raise 695,000 pounds one foot high against the force of gravity, or would do 695,000 foot-pounds of work. In an ounce of gunpowder is stored about 100,000 foot-pounds of energy. An ounce of zinc represents a store of only 113,000 foot-pounds. An ounce of copper represents a store of about 69,000 foot-pounds only. An ounce of hydrogen gas will yield, by combining with oxygen, 2,925,000 foot-pounds of work.

The Electric Light Companies.

In the following resume of the market for electric light shares, the figures given are of sales that have been made through brokers. But higher prices may have been obtained at private sales.

The Edison Electric Light Company, the parent company and pioneer in the field, was originally organized with a capital of $300,000. This was increased to $460,000, and then to $720,000. The company owns about 51 per cent. of the stock of the Edison Illuminating Company, which was organized to use the Edison inventions in this city, and of the stock of the Edison Company for Isolated Lighting. The value of these holdings is taken into consideration in estimating the value of the shares of the parent company. When its capital was $300,000, its $100 shares sold as high as $3,700. Three shares sold at that price The purchaser of these shares is reported to have sold them at private sale on the same day for $5,000 a share. The original seller paid $2,000 a share. He therefore made $5,100, and the second seller made $3,900. All of these transactions, it is said, took place in one day. One of the first transactions in this stock was the sale of five shares for $1,000, or $200 a share. On the day after this sale, the purchaser sold two of the shares for $500 a share, thus recovering the amount of his purchase money for the lot. He afterward sold the three remaining shares for about $8,000, which was his profit on the venture. At times the price jumped up $100 a share in an hour. The son of the president of one of the largest corporations in the country sold 20 shares that cost him $2,000—that is to say, $100 a share—for $23,500, or $1,175 a share. The purchaser sold the stock shortly afterward for $1,375 a share. The stock is now selling at the lowest figure it has touched since it came upon the market, namely, $250 a share. A sale was made at that figure not long ago. The price has twice been affected by the increase of the company's capital, as the increase in capital has been offered to the stockholders at par. At the present market value of the shares of the Edison Illuminating and of the Edison Isolated companies, it is estimated that the stock of the parent company is worth about $150 a share, merely as representing the interest of each share in the aggregate market value of the stocks held by the company.

The capital of the Edison Illuminating Company is $1,000,000, and the par value of its shares is $100. Fifty-one per cent. of its stock was given to the parent company for the Edison patents, which it is entitled to use exclusively in New York City. The company proposes to light the city by districts. Its first district is bounded by Spruce street, Park row and Broadway, and the East River. It has equipped an engine-house in Pearl street, and laid wires and put in fixtures extensively through this district, but has not yet succeeded in furnishing any light to speak of, though it has about 6,000 lamps, which have been lighted at times. The stock of this company has sold as high as $125 a share, and as low as $30. The former price was reached before the company had got much of its plant, and the latter a few months ago. The last sale is reported to have been at $50 a share, and it is now offered at $50, $40 a share being bid for it.

The Edison Company for Isolated Lighting was organized with a capital of $500,000, which was subsequently increased to $1,000,000. The par value of the shares is $100. The object of the company is to furnish light by the Edison system, and patents to single buildings or establishments. Fifty-one per cent. of its stock is owned by the parent company, having been issued to it for the patents and privileges. When the capital of the company was $500,000, its stock first sold up to $240 a share, and then as low as $175 a share. The stock now brings $155 per share. It is offered at $155, and $140 is bid. The price at present, however, depends to an extent upon the number of shares offered or bid for. This is the only Edison company that has paid a dividend. One of ten per cent. out of the operations of the last

year has recently been declared. Though the parent company has never paid a dividend, large profits have accrued to its stockholders by two awards of new stock at par at times when the premium was very great.

The Edison Electric Light Company of Europe was organized about two years ago, simultaneously with the other offshoots of the original company. Its capital is $2,000,000, and the par value of its shares $100. It has a monopoly of the Edison system in Europe. Its stock sold soon after it came on the market at $165 a share, and has declined to $40. The present quotation is $40 bid, $55 asked.

The capital of the United States Electric Lighting Company is $1,500,000. Its shares, of the par value of $100 each, sold about three years ago at $300 per share. During eextreme depression in this class of stocks about six or seven months ago its stock sold at $82.50 a share. The last reported sale was at $125, and at present $130 is bid and $150 is asked. The company has just declared its first dividend. It is five per cent. in cash, but whether it is to be considered as an annual, a semi-annual or a quarterly dividend cannot be learned.

The patents of the United States Company are used extensively in this city by the United States Illuminating Company, which has a capital of $1,000,000, only one-half of which has been issued. The transactions in its stock have not been large. The last was at $103 per share.

The Brush Electric Company of Cleveland sustains practically the same relation as the Edison to several minor companies. It has a capital of $3,000,000 in $100 shares. The stock sold recently at $110, and it is said that it can be bought at that price now. The present bid price is $100. It has never sold below its par value. The company has paid quarterly dividends of two per cent. for three years.

The Brush Illuminating Company of New York uses the Brush inventions and systems in this city. It furnishes, it is said, over 1,000 lights nightly in the up-town districts, which it supplies at an average price of 80 cents a light per night. It began furnishing street-lights to the city at 40 cents a light per night, but the price has been advanced to 70 cents. The cost to the company is said to be 50 cents. It is reported that the company will earn $100,000 net this year. The capital is $1,000,000, and the $100 shares have sold as high as $125, and about three months ago had dropped to $70. The current quotation is $100 bid, and $110 asked.

The Brush Illuminating Company of New York owns most of the stock of the Brush Electric Light Company of New England, which uses the Brush system throughout the Eastern States. This stock is not dealt in, but is supposed to be worth about $500 or more a share. The company has just declared an extra cash dividend of 30 per cent., making a total of 58 per cent. that it has paid within a year. The report is current that the New York and New England companies contemplate a consolidation.

The Fuller Electrical Company manufactures electrical machines. It has a capital of $870,000, of which $300,000 is common stock and $570,000 preferred. The par value of both classes is $100. The common stock has sold from $32 to $22 a share, and the preferred from $61 to $75 a share. Present quotations are $30 bid for the common, offered at $32, and $75 bid and $100 asked for the preferred.

The American Electric Light Company has been distinguished chiefly for the counter charge of fraud that some of its officers exchanged a few months ago. The company has a capital of $500,000 in $50 shares. Some of these shares have sold at $35. They are now offered at $4.75.

The Brush-Swan Electric Light Company is the last organized enterprise of this class. It combines all the Brush and Swan inventions, and uses electricity generated by the Brush process in the Swan incandescent lamp. The capital of the company is $600,000, and the par value of its shares is $100. Sales have been made at $150 a share, and it is now quoted at $105, and $150 asked.

For the common protection of their patents, all of the leading electric light companies formed, some two years ago, the Gramme Electrical Company. The shareholders are the American Electric Company of New Britain, Conn.; the Brush Electric Company, the Edison Eleetric Light Company, the Fuller Electrical Company, the Jablochkoff Electric Lighting Company, the United States Electric Lighting Company, and the Weston Electric Light Company. The stock has no marketable value.

While the prices that now prevail for the shares of most of the electric light companies are the lowest that have ruled, it will be observed that there has been a considerable recovery in the case of those companies which have demonstrated their ability to make returns upon the money invested in them. These, however, are few in number, and, with the exception of the Edison Isolated, are companies that furnish only the large lights that can be utilized chiefly for out-door lighting or for the illumination of large areas. The small light that is required for general in-door illumination has not yet been furnished for general use, nor has any return been made upon the money invested in its development and introduction. Where bills have been rendered for furnishing the light suitable for office or house purposes, they have, according to some persons who have paid them, been larger than a gas bill would have been for the same amount of service. So far as speculation is concerned, however, the inquiry for electric light shares is, according to the brokers, increasing, and the volume of the transactions larger as compared with three or four months ago, when trading in them was at a standstill. This, doubtless, is largely due to the first dividends recently declared by two or three of the companies.

An experiment was made on Wednesday last at the main offices of the Postal Telegraph Company in this city, with the long circuit telephone, invented by C. E. Scribner and controlled by the Western Electric Company, in talking between New York and Chicago. The wires of the Postal Telegraph Company were used. Conversation was carried on with the offices of the Postal Company at the Chicago Stock Yards, and the replies were heard as distinctly as they are heard over local short circuits. Professor Gray, the electrician of the Postal Company, had a short talk with a reporter of a Chicago newspaper, and several tunes played by Mr. Scribner at the Chicago end of the wire were heard clearly at the New York end.

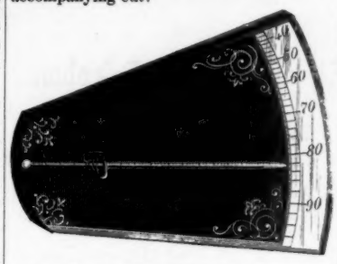
Mr. Leslie, the General Superintendent in Washington of the Mutual Union Telegraph Company, has accepted the position of General Manager of the Postal Telegraph Company, with headquarters in New York, and will soon enter upon his new duties. Mr. Leslie says that he shall advise from the start the policy of seeking entrance to cities underground. The outlay in the first instance will be much larger than the overhead system, but he is confident that in ten years the company will find it to its advantage to have its wires underground, as a matter both of economy and convenience.

According to the official statement of the Mexican Department of Public Works, there had been built in Mexico up to the close of 1882 about 2,305 miles of railway. The miles of track now operated is given as follows: Mexican Railroad (Vera Cruz), 356 miles; Mexican National, 432; Mexican Central, 596; Sonora Road, 318; Interoceanic Road, 188; Yucatan railways, 60; Tehuantepec Road, 16.

The passage of the Alaska, which arrived at Queenstown from New York early on the 7th ult., was seven days three hours thirty-six minutes, her runs being as follows for each of the days: 304, 410, 393, 410, 355, 399, 395, and 232 miles. Her best run, 410 miles, represents a speed of a little over 17 miles an hour.

The Balanced Thermometer.

This instrument has an important advantage over the ordinary thermometer in the fact that the temperature may be read at any required distance from the instrument. A room instrument of this kind is shown in the accompanying cut:



A graduated tube, filled with mercury or spirit, is balanced on needle points, the small end of the tube acting as a pointer on a dial or arc. After being adjusted, so that the pointer indicates the same temperature as shown in the tube, the weight of the mercury regulates the rise and fall of the pointer to show the correct temperature of the room. This is a recent invention, patented December 26, 1882—Messrs. Kirk and Brayton, patentees.

We have one hanging in our office, and it is certainly a convenience to notice the temperature of the room at a glance without stopping work to do so.

The instrument is manufactured at Geneva, N. Y., by the Geneva Balanced Thermometer Company. There is some prospect, we learn, of a New York company being organized in connection with it.

NEW BOOKS.—Just published, by E. & F. N. Spon, 44 Murray street, New York—Elements of Construction for Electro-Magnets. By Count Th. du Moncel. Translated from the French by C. J. Wharton. Crown 8vo, cloth, 75 cts., postpaid.

Contents: Formulas for Electro-Magnets. Conditions of Maximums for Electro-Magnets on a Simple Circuit. Conditions of Maximum on Compound Circuits. Application of the Laws of Maximum to the Construction of Electro-Magnets. Numerical Examples of the Application of the Preceding Formulas. Experimental Verification of the Laws of Electro-Magnets. Effects of a More or Less Complete Magnetic Saturation. Conditions for the Good Construction of Electro-Magnets. On the Best Grouping of the Cells of a Battery. Tables.

Extract from Preface: "In presenting the accompanying translation of the 'Determination des Elements de Construction des Electro-Aimants,' by Count Th. du Moncel, I need offer no apology, as the researches of this eminent French scientist are well known both in England and America; but to facilitate the studies of those not understanding French, I have undertaken the translation which I now put forward as a faithful copy of the original, but in an English dress. The electrical units are almost throughout based on the French system of measurement of a Daniell as the unit of E. M. F. and the meter of telegraph wire as the unit of resistance, but to calculate these values according to the mode now usually obtaining here, viz., the volt and the ohm, the results must be divided by 1.079 and 100 respectively. In conclusion, I am requested by Count Th. du Moncel to explain that the experiments undertaken by him in order to determine the ratios of magnetic moment for the standard electro-magnets have not been numerous and varied enough for them to be taken as presenting great exactitude. Further experiments in this direction would therefore be of advantage; and it must also be borne in mind that, owing to the varying nature of the iron employed in electro-magnets, we can never be certain that the real results correspond with the theoretical. What, however, may be taken as certain is that electro-magnets constructed and used in accordance with his formulas are employed in the most advantageous manner possible."—C. J. WHARTON, Translator.

The census reports of railroads recently published show that at the time the report was prepared there were in operation 86,791 miles of road. The work done by these miles of roads can be represented as equivalent to the carriage of one ton of freight 32,348,846,693 miles, and one passenger carried 6,189,240,914 miles.

The receipts were, per freight train, per mile, $1.65; expenses, 98 cents; profits, 67 cents per mile. Receipts per passenger train, per mile, $6.19; expenses, 76 cents; profit, 43 cents. Receipts per ton, per mile, $1.28; expenses, 76 cents. profit, 52 cents; profit per passenger mile, 62 cents.

Average rate on local freight, 1.64 cents per ton per mile; on through freight, 1.01 cents.

The traffic was equivalent to 98 passengers and 510 tons of freight each way daily over the entire mileage.

The average train load for the whole United States was 44⅛ passengers and 129 tons of freight, equal to a full car of passengers and 11 cars of freight.

The average freight rate per ton per mile, 1.29, is less than in any other country. The average passenger rate is 2.33.

The census shows there were 418,957 persons employed, or an average of 4.8 per mile of road. Wages paid, $195,350,013, or an average of $466.23 per man per year.

Gross earnings, $580,450,594, or $6,688 per mile of road. Working expenses, 60¾ per cent., or $4,065 per mile. Net earnings, $2,623 Other sources of revenue increased the aggregate sum available for distribution to $245,786,907, which was 4 91 per cent. on the whole amount of capital stock and funded debt. Amount paid as dividends, $119,344,597, or 4.5 per cent. on investment.

Dividends actually paid, 2.7 per cent, amounting to $70,000,000, or $813 per mile of road, and to 12 per cent. of gross earnings.

The common practice of having night lights in the bedrooms of children of well-to-do parents is deprecated by Dr. Robert H. Bakewell. He says that it has a most injurious effect upon the nervous system of young children. "Instead of the perfect rest the optic nerves ought to have, and which nature provides for by the darkness of the night, these nerves are perpetually stimulated, and, of course, the brain and the rest of the nervous system suffer. Children thus brought up are excessively timid for years after on going into the dark."

Messrs. John A. Roebling, Sons & Co. recently sent from Trenton, N. J., to San Francisco, a wire rope, 1½ inches in diameter and over four miles long. It is for a cable street railroad in San Francisco, and, it is claimed, is the longest and heaviest wire rope ever made in the United States. The rope weighed about twenty-five tons, and was loaded on two flat cars, secured together by chains, in addition to the usual coupling. It was sent over the Pennsylvania Railroad.

The Bethlehem Telephone Exchange is known throughout Pennsylvania as being one of the finest and most handsomely fitted up exchanges. It has two of the latest fifty-wire Gilliland switches, and has eighty wires connected therewith. The subscription list exceeds one hundred, and have more private residences, physicians, druggists, etc., than any other exchange in Pennsylvania, considering the population of the town. There are between nine and ten hundred calls attended to daily by two young ladies, Miss Groman and Miss Waters. The service is excellent. Much credit, however, is due to Mr. Irvin J. Lerch, the efficient manager of this model little exchange.

We note among our exchanges *The Electric Light*, a bright little eight-page monthly, published by Geo. R. Morse, Esq., of Rochester, N. Y.

Sixty Edison lamps have been put up in a carpet factory in Helsingfors, Finland.

NEW PATENTS—ELECTRICAL—1883.

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING MARCH 20th, 1883.

274,181 Apparatus for substituting gas for electric light; Patrick B. Delaney, New York.
274,150 Cut-out for dangerous electric currents; Frederick A. Swan, and Charles B. Bosworth, Boston, Mass.
274,323-4 Circuit controller for electric clocks; Vitalis Himmer, New York.
274,452 Circle Switch for galvanic batteries; Henry Lowe, Brooklyn, N. Y.
274,417 Dynamo-telegraphy; Henry Van Hoevenburg, Elizabeth, N. J.
274,151 Electric cut-off; Frederick A. Swan and Charles B. Bosworth, Boston, Mass.
274,293 Electric lamp; Thomas A. Edison, Menlo Park, N. J.
274,297 Electric lamp cut-off; John H. Elfering Chicago, Ill.
274,325 Electric clock; Vitalis Himmer, New York.
274,353 Electric telephone trasmitter; James A. Maloney, Washington, D. C.
274,371 Electric current regulator; Charles G. Perkins, Camden, N. J.
274,370 Electric arc lamp; Charles G. Perkins, Camden, N. J.
274,413 Electric arc lamp; Elihu Thompson, New Britain, Conn.
274,445 Electric clock escapement; Adelbert W. Gray, New York.
274,110 Galvanic battery; Felix de Lalande, Paris, France.
274,294 Incandescing electric lamp; Thomas A. Edison, Menlo Park, N. J.
274,295 Incandescent electric lamp; Thomas A. Edison, Menlo Park, N. J.
274,427 Incandescent lamp holder; Edward Weston, Newark, N. J.
274,296 Manufacture of incandescents; Thomas A. Edison, Menlo Park, N. J.
274,300 Printing telegraph; Stephen D. Field, New York.
274,416 Printing telegraph; Henry Van Hoevenbergh, Elizabeth, N. J.
274,352 Receiving telephone; James A. Maloney, Washington, D. C.
274,290 System of electric distribution; Thomas A. Edison, Menlo Park, N. J.
274,292 Secondary battery; Thomas A. Edison, Menlo Park, N. J.
274,373 Secondary battery; Jas. Pitkin, Clerkenwell, County Middlesex, England.
274,112 Telegraph apparatus; Georges D'Infreville, New York.
274,212 Telegraph and semaphore signal; Wm. W McLellan, Newcastle, New Brunswick, Canada.
272,246 Telephonic transmitter; Clement Adder, Paris, France.
274,213 Underground conduit for electrical conductors; Henry Robert Meyer, Liverpool, County of Lancaster, England.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

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Business Notices.

The attention of persons interested in local telegraph and telephone organizations is respectfully called to the electric lighting system of The Fuller Electrical Compan and the practicability of making arrang ments with that company for the introduction of its apparatus, either in isolated plants, or through the formation of local companies desiring to engage in the business of electric lighting. The specially valuable feature of this company's system may be seen by examination of its apparatus in Boston, Worcester, Providence, Hartford, New York City, Brooklyn, Jersey City, Paterson, Philadelphia, Lancaster, Scranton, Syracuse, Rochester, Buffalo, Pittsburgh, Wheeling, Steubenville, Xenia, Dayton, Grand Rapids, Chicago, Springfield, Belleville, St. Louis, St. Paul, and many other smaller places throughout the country. Correspondence is invited.

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ELECTRICAL REVIEW.

INTERNATIONAL

Electric Exhibition

VIENNA, 1883.

The Commission of the International Electric Exhibition at Vienna, 1883, gives due notice to the public that this Exhibition is to take place in the course of this year, to be opened on the **1st August,** and to be closed on the **31st October,** and cordially invite Exhibitors and Visitors. The Regulations and the blanks necessary for Applications are to be had at the **Austrian-Hungarian Consuls.** The objects to be exposed will comprise all Machinery, Apparatuses and Implements connected with Electrotechnic. It will certainly afford a good opportunity to inventors to show their latest improvements. This Exhibition is greatly favored by the Austrian Government, and will be held in the Rotunda of the well-remembered Universal Exhibition of 1873. Exhibitors are requested to procure the necessary papers at once.

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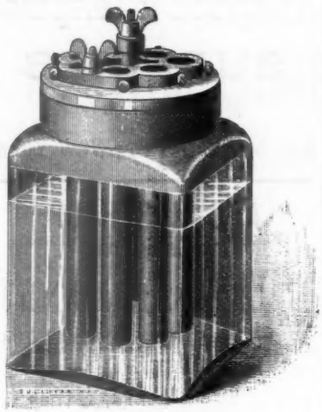

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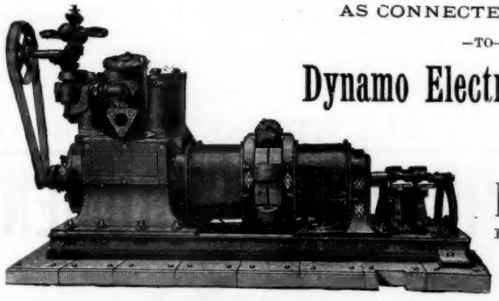

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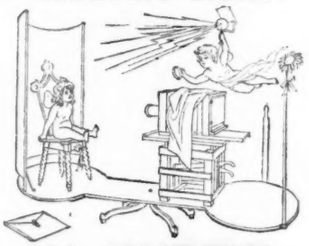

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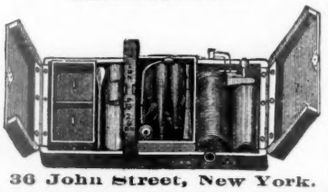

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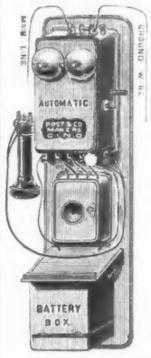

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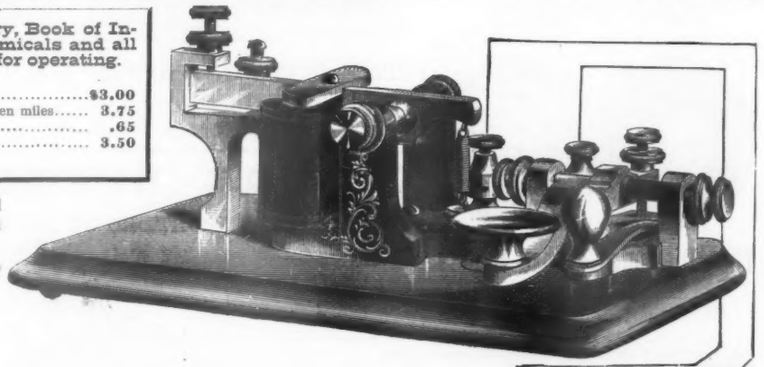

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